THURSDAY, AUGUST 13, 1896.

TABLES FOR NAVIGATORS.

Azimuth Tables for the Higher Declinations (limits of declination 24° to 30°, both inclusive) between the parallels of latitude 0° and 60°, with Examples in the use of the Tables in English and French. By H. B. Goodwin, Naval Instructor, Royal Navy. Pp. xii + 74. (London: Longmans, Green, and Co., 1896.)

A LEADING feature of present-day methods of navigation is the use of tables. There is scarcely any method in use in navigation for which one, and probably many, tables, of more or less practical utility, are not provided; and it would almost appear in some cases as though new methods had been proposed because tables could be prepared to use in connection with them, rather than because they were of real practical use. Some tables, such as those for "reduction to the meridian," may almost be regarded as luxuries, as they really save but little time and labour; though, on account of the easy adaptation of the formulæ to different forms of tabular computation, the number of them is large. On the other hand, there are tables which are really indispensable.

Of this latter class azimuth tables are a prominent type.

The object of the first of these azimuth tables, by Burdwood, published about a quarter of a century ago, was, to judge from the preface, merely to facilitate the calculation of compass error. Its publication, however, and that of its extension by Davis, may be said to have effected a revolution in the art of navigation, as Sumner's method, now so extensively used, was thereby rendered practically useful.

This method, of which the principle had been before recognised, was proposed by Captain Thomas Sumner, of Boston, in the year 1837. It enabled the navigator to determine *both* his latitude and longitude at *any* time, instead of being restricted to observations of the heavenly bodies, when near the prime vertical, for longitude; and when on or near the meridian, for latitude; observations for determining the latitude, in other cases, depending on a long process known as the "double altitude."

The principle of this method, as to which Lord Kelvin has remarked that every other method of navigation might be abolished so long as it was retained, is, that when the altitude of a heavenly body is observed, the observer must be situated somewhere on that small circle on the earth's surface which has the heavenly body as its pole. Another observation of the same body, when its azimuth has sufficiently changed, or of another body, at the same time, with an azimuth differing considerably from that of the first, places the observer, similarly, on another small circle. His actual position must therefore be at one of the two points of intersection of these circles; and, as these points are usually a long distance apart, his position, known approximately, will decide the question.

These circles, when transferred to a Mercator's chart, form regular curves, and the chords joining any two points on these curves within a few miles of each other, or the tangents to the curves through any points on them, such chords or tangents practically coinciding with the arcs, are called "lines of position." The intersection of two such "lines of position" fixes the position of the ship on the chart.

For the chord method the calculation of four longitudes would be necessary, *i.e.* two longitudes obtained from each of the altitudes with two assumed latitudes in the neighbourhood of the latitude by account; or else two longitudes and two latitudes when the heavenly body was near the meridian at the second observation. For the tangent method would be required two longitudes, or a longitude and a latitude, and two azimuths, as from the conditions of the problem, the tangent "line of position" must be at right angles to the heavenly body's azimuth.

Thus Sumner's method, though useful, was long and tedious, Captain Sumner himself remarking that the calculations would be much shortened and simplified it some ready means could be found of obtaining the azimuth of the body observed. This ready means is provided by Burdwood and Davis' tables. The longitude is calculated with the latitude by account; the azimuth taken from the tables, and the "position line" drawn through the position obtained. A second line is similarly drawn, the latitude being calculated, by reduction to the meridian, with the longitude by account, when the body observed is near the meridian, and the intersection ot these two lines fixes the position of the ship.

Thus the cumbrous chord method is done away with, the tangent method is shortened and simplified. "Summer," therefore, almost deserves the character given to it by Lord Kelvin, especially as it is very usefu in high latitudes, in the winter months, during which the sun, when it does appear, is never very near the prime vertical, and the longitude obtained from observation ot it is not so trustworthy.

Burdwood and Davis' azimuth tables give the true bearing or azimuth of any heavenly body whose declination lies between 0° and 23° north or south, for limits of latitude 0° to 60° north or south, for every four minutes of apparent time (in the case of the sun) or of hour angle (in the case of any other body). They are, therefore, most useful for obtaining the azimuth of any such body for compass error or line of position.

But the great increase in the speed of modern steamships necessitates more frequent observations in order to obtain the position of the ship. The correct position at noon each day was almost all that was required in the days of sailing ships and ships of low steam power. But now that ships may run 200 miles between noon and sunset on a summer's day, and considerably more between sunset and sunrise on a winter's night, it is necessary to know the position as often as possible, and strict orders are issued to the officer of the watch in Atlantic liners to omit *no* observation by which the ship's position may be determined.

Hence observations of the moon, the planets, and the stars are becoming of more frequent occurrence. One great advantage of observations of the moon is that it is frequently to be seen after sunrise or before sunset, and the position can be, therefore, readily fixed by simultaneous observations of the sun and moon (Sumner). Observations of the planets and stars can be made with *very* great accuracy in the twilight, and afford most satis-

factory results. There is, however, in the minds of many mariners an ill-defined idea that any problem not depending on the sun is too difficult to be meddled with. But so great a practical authority as Captain Lecky, in "Wrinkles on Navigation," says :

"For four or five months of the year navigation in our own latitudes is a much less ticklish affair when the stars are brought into action. In most cases they can be selected on or nearly on the prime vertical during twilight, and will therefore give a very reliable longitude."

The object of the present tables is to render Sumner's method applicable to the moon and planets in *all* cases, and to such bright stars as lie up to 30° of declination. The stars tabulated on page vii. of the preface are practically all available for longitude, and nearly all for latitude also.

The moon for about two-thirds of each month lies within the limits of "Burdwood and Davis," but for the remaining third it lies outside; and, as an example of a planet, Mars in 1896 has a higher northern declination than 23° from October 3 onwards.

When it is considered that the simultaneous observation of the sun and moon, already referred to, is admitted to be of great practical use even by those who are sceptical as to the general utility of observations of the moon, tables which permit Sumner's method to be applied to the moon at *all* times, at once establish their practical utility; and further, referring to the above-quoted opinion of Captain Lecky, it is to be remarked—

"That it is the very stars between 23° and 30° of declination (same name as latitude) which are particularly suitable for observation on the prime vertical, for the reason that in our latitudes such bodies have at the time a convenient altitude, whereas those of lower declination are too near the horizon when they have a bearing due east or west."

In this case again the practical value of the tables is obvious.

A somewhat interesting illustration of the value of observations of the stars is given in an article in the *Nautical Magazine* (June 1896). The article treats of the cross-currents said to be experienced in the Red Sea. Their existence was inferred from the discrepancy often noticed in the position of a ship as obtained from a.m. or p.m. observations of the sun. Recently, however, it has been considered that the discrepancy arises from the abnormal refraction experienced in the Red Sea, by means of which the position of the horizon is altered sufficiently to account for large errors in longitude.

In order to endeavour to settle the question numerous observations have been made, and the results tabulated. In a report on the subject by the Hydrographer of the United States, giving a detailed account of what has been done, the following paragraph occurs.

"The good agreement obtained between the results of the observation of dawn and twilight stars shows that excessive refraction is less frequent at those hours than at other hours of the day."

Tables, therefore, which tend to promote and simplify observations of the stars, when a ship is traversing a sea so full of dangers to navigation as the Red Sea has shown itself to be, should prove to be a boon.

In "Burdwood and Davis" the arguments are latitude, declination, and time. In the present tables "altitude" takes the place of "time" in the principal table. Table B is of use in the case of observations made when the altitude is greater than 55°, or is within 2° of the meridian altitude, the change in altitude being then so slow in comparison with the change of azimuth that it can no longer be regarded as a suitable argument. Table B is also of use in Sumner's method when an observation is made near the meridian, and the latitude calculated with an assumed longitude.

The use of altitude as an argument gives somewhat less minute results than the four-minute intervals, but there are great compensating advantages. The hour angle of the sun (or ship apparent time) is very readily found; but to find the hour angle of the moon, a planet, or a star, is a much more complicated matter. It involves a knowledge of ship time, right ascension of the sun, and right ascension of the body, presenting in addition a somewhat puzzling variety of cases. But the altitude of a star, &c., can be *accurately* observed in a few moments in the twilight when latitude or longitude is required, and can be observed with quite *sufficient* accuracy at any time, when visible, for the purpose of obtaining the azimuth or true bearing.

And this leads on to the second reason for the publication of these tables.

The process of observing the compass bearing of a bright star has been of late years very much facilitated by the introduction of Lord Kelvin's compass, so that the mariner has now the means of obtaining the error of his compass and of checking his deviation table at any time of the day or night when any of the heavenly bodies are visible. Here again we may quote Captain Lecky, who says: "It is perfectly wonderful how few men avail themselves of the stars on a fine night to see how their compasses are behaving." These tables, with the simple argument of a fairly correct altitude in place of a complicated hour angle, should render the practice of star observations for compass error as frequent as they are simple.

Such observation would appear to be most useful to the navigating officer of a ship of high speed, who may find that the variation has altered several degrees between sunset and sunrise. For example, in a ship steaming in the direction of New York, from latitude 45° N., longitude 60° W., it would be found that the variation had altered about 8° in a run of 300 miles, a distance that might very easily be traversed between such times as the sun was available for observation. It must therefore be of great assistance to the navigator that he should have a certain means of checking his compass error, not by the sun only, but by any heavenly body, of suitable and easily ascertained altitude, that may be visible.

Example iii. shows very clearly the value of the process (Examples i. and ii. showing the use of the tables as an aid to Sumner's method in the case of the stars and moon).

The methods for determining compass error show continual development. Formerly it was found by amplitude only, *i.e.* by the azimuth of the sun when its centre is on the horizon.

But, on account of refraction, the sun's centre appears to be about a diameter above the horizon when it is

really on it, and the correct position has to be guessed at. This never could be very satisfactory, and, in high latitudes with sun's declination of the same name, it is absolutely useless, as, owing to the small angle made by the path of the rising or setting sun with the horizon $(\cos^{-1}\{\sin \text{latitude} \cdot \sec \text{declination}\})$, the sun's azimuth may change several degrees while the altitude changes half a degree, so that it is practically impossible to estimate with any approximation to accuracy the correct amplitude; and when the sun's declination is greater than the co-latitude, the sun does not set at all.

Amplitude tables appear in all collections; but they might very well be dispensed with now that the compass error can be obtained with accuracy at any time of the day and night with the aid of "Burdwood and Davis," and the present extension to higher declinations.

In conclusion, a word of praise may be given to Messrs. Longmans for the clear and distinct manner in which the tables are printed.

F. C. STEBBING.

CAVERNS AND THEIR INHABITANTS.

Les Cavernes et leurs Habitants. Par Julien Fraipont. Fcap. 8vo, pp. viii + 334. (Paris: Baillière et Fils, 1896.)

THE exploration of caverns during the twenty years which have passed since the publication of "Cave Hunting," has been carried on with an ever-increasing interest in various parts of the world. In France M. Martel has proved, by his adventurous descents into the abysses of these great laboratories of nature, that there is a charm in exploring them, similar to that which attracts the traveller to the highest summits of the mountains. If any one doubts this, let him read "Les Abîmes," where he will find a tale of descents into the principal European caverns that will remind him of the *Alpine Journal* turned upside down. In Central America the "Hill Caves of Yucatan" have allured Mr. Mercer to an expedition, the results of which have been recently published with admirable photographs. Here, as generally if not universally in the American caves, we look in vain for any traces of man older than the ancestors of the Indian tribes. In the book before us Prof. Fraipont, who had already made his mark as one of the discoverers of the human remains in the cave of Spy, deals with the general questions shortly and popularly, and with ample illustrations.

Our author treats, in the first place, the physical history of caverns, and divides them into those that have been formed by water and those which are of volcanic eruptive origin. In the first of these groups the caverns formed by the mechanical action of subterranean waters, combined with the chemical action of the carbonic acid in the water itself, are rightly separated from those formed by the erosive attack of the sea. The second group consists of those formed by the flow of liquid lava from a lava stream, after the upper parts and sides have cooled into the solid rocky condition. Caves of this sort are found in most volcanic areas, and notably in the island of Réunion and in Southern Italy. Prof. Fraipont classes with these the basaltic cave of Staffa, obviously the result of the attack of the waves on a line of weakness in the prismatic basalt. It is a sea cave pure and simple, and has no place in this group.

Prof. Fraipont, as might naturally be expected, passes by the present fauna of the caverns with a brief notice: the blind insects, the blind fish (*Amblyopsis*) of Kentucky and (*Lucifuga*) of Cuba, the blind *Proteus* of Carniola, and the large-eyed rat (*Neotoma*) of Kentucky that sees indistinctly. All these, so important from the light which they throw on the effect of the environment on their organisation, have no special interest in a work mainly given to the story of man in the Pleistocene caverns. To this we shall devote the rest of this review.

The Pleistocene caverns are treated from the usual standpoint of the French archæologist, and are divided into three groups, according to the alleged differences in the fauna and the occurrence of certain types of implements. (1) Those of the period of *Elephas antiquus* and *Rhinoceros merckii*, or the Chelles period; (2) those of the period of the mammoth and *Rhinoceros tichorrhinus*, or that of Moustier; and (3) those of the reindeer period. This classification is founded on the assumption that these mammalia and implements are characteristic of each division. Some animals preponderate in some caverns, and others in others, according to their habitat, and also according to the selection made by the hunters, who could kill, say, the reindeer more easily than the mammoth. As a matter of fact the study of the Pleistocene strata in France, as well as in Germany, Belgium and Britain, proves that all the above animals belong to one fauna in Pleistocene Europe. All have been found side by side in the gravel beds, for instance, on the banks of the Ouse at Bedford. The fact that the reindeer folk hunted the mammoth, as well as the rhinoceros, in France, is proved by the incised figures left behind as memorials of the chase. The differences in the implements, with the exception of the first, are probably local and due to tribal isolation, or to the scarcity or abundance of the materials for implement-making. The only two clearly-marked divisions, applicable to the whole of Europe, are (1) the Chelles period or that of the river-drift, and (2) that of the two latter of Mortillet (if Solutré be included, three) or that known to English archæology as that of the cave-men.

Human implements have been repeatedly met with in various caverns in France and Britain, and in the lower strata of Spy, in Belgium, which belong to the River-drift time; but with the exception of a solitary molar, found in one of the caves in the valley of the Elwy, no human remains have been discovered. It has been the good fortune of Profs. Fraipont and Lohest to find, in the cave of Spy, the first human skeletons, which belong beyond doubt to the cave-men, and are sufficiently perfect to allow of our arriving at a conclusion as to their physique. They are small with short arms and legs, and with a prognathous skull with low forehead, and enormous orbits overhung by strong superciliary ridges, with broad, strong cheek-bones, and with a long vault, similar to that of the skull of Neanderthal. They had small canines, and thigh-bones round in section, and without trace of platycnemism. Without accepting our author's view that they represent a "race humaine à caractères ethniques le plus inférieures que nous connaissons," we may conclude that they represent a family group of a

low type, which may be proved by future discovery to be a well-defined race, spread widely on the continent. We agree with him that the cave-men used fire-sticks, but we wait for further evidence before we can accept the conclusion that they were acquainted with the art of pottery-making. The cups, with round bottoms, found in the caves of Engis and Modave, are of the types met with in the lake-dwellings of Switzerland, such as Moringen and Concise, and are probably of Prehistoric and not of Pleistocene age. Nor can we accept his identification of the *Felis spelæa* with the tiger. It has been clearly shown in the Palæontographical Society's Memoirs, some twenty years ago, that it is a lion, differing from the tiger both in the shape of its skull and of its lower jaw. In treating of the range of this animal, our author has been unfortunate. In page 123 he tells us that "the great tiger of the caverns had disappeared in the Reindeer age," and, four pages later, that it was then alive. He speaks of it in one place as a tiger, in another as intermediate between a lion and a tiger, and in a third as an "extinct" type. His inclusion of the *Bos longifrons*, the goat, and the rabbit among the Pleistocene mammalia of France and Germany, is also open to doubt, the two first being probably introduced in the Neolithic age as domesticated animals, and the last having found its way northwards from Spain at a later time.

Although the Mammalia and, it may be added, the spelling of the names of places, people, and animals, are weak spots, the book may be summed up as an interesting addition to the literature of a complex and difficult subject, to which it forms a hand-book with valuable references. W. BOYD DAWKINS.

THE PHOTOGRAPHY OF HISTOLOGICAL EVIDENCE.

Atlas of Nerve-cells. By M. Allen Starr, with the co-operation of Oliver S. Strong and Edward Leaming. Pp. x + 78. 53 plates. (Published for the Columbia University Press by Macmillan and Co., New York and London, 1896.)

"A CAREFUL drawing by a trained observer gives a better idea of appearances seen under the microscope than the best reproduction by photography can at present achieve." This statement was called forth by the consideration of a book similar in idea to the present, and apparently one of the same series, the "Atlas of Fertilisation and Karyokinesis of the Ovum," and was made a short time ago by Prof. Weldon in a notice of that book in NATURE. It is forcibly recalled by the present book, the authors of which have been at the pains to present photographic representations of preparations showing nerve-cells, mostly prepared by the method of Golgi, any and all of which representations might with the greatest advantage, so far as clearness and facility of comprehension is concerned, have been replaced by a careful drawing of the cells which it was designed to illustrate.

The first idea that is evoked on looking at such plates as are here given, is that they are beautiful photographs of equally beautiful preparations. But the question *cui bono?* immediately forces itself upon one's mind. Are they intended to exhibit to other investigators the results of the author's investigations? This can hardly be the case, for it is not claimed that they show anything new, and every investigator can more or less readily make such preparations for himself. Are they intended for the student? This equally cannot be, since they are given in an expensive form, and are for the most part lacking in clearness; not from any fault in the preparations, but because the camera cannot be got to see more than one plane at a time. It is the hand which is constantly on the fine adjustment of the microscope that enables the shape of the body of a nerve-cell and the course of all its branches to be followed accurately, and it is only accidentally and imperfectly that these can be shown in a photograph.

The authors have themselves furnished the best possible illustration of the comparative value for teaching purposes of accurate drawings from good preparations, and of the best possible photographs from the same preparations, in giving (on p. 72, Fig. 10) a diagram of the cells of the cerebral cortex, "the cells being reproduced from the plates" (it would probably be more correct to say from the preparations). This diagram shows the cells with all their processes in relation to one another in the clear manner which we are accustomed to associate with representations of Golgi-preparations, and presents a marked contrast to the difficulty with which we make out some of the points which are stated to be shown in many of the photographs.

Moreover, as an account of the structure of the nervous system, which appears in some measure to be aimed at in this book, although not indicated in the title, the text which accompanies the plates is of no great value, since more complete and accurate accounts are within the reach of every student. It is indeed remarkable, considering that Dr. Allen Starr is the principal author, that quite serious errors, both of omission and of commission, should have found their way into the text. Thus, to take a single part of the nervous system, in a special enumeration of the connections of the cerebellum, the passage of the tract of Gowers into it by way of the superior peduncle—a fact indicated by Löwenthal and conclusively demonstrated by Mott—is ignored. On the other hand, the extensive descending degenerations described by Marchi, which have since been shown to have been produced in all probability by injuries to the bulb, accidentally made on removing the cerebellum, are still put forward as indicating an important centrifugal connection of the cerebellum with the spinal cord.

It may, further, be remarked that the present authors, like many others who have lately treated of the structure of the nervous system, have altogether failed to appreciate the importance of adopting for the nerve-cell a terminology which shall bring it into a line with all other cells in the body. Instead of speaking of the *body of the cell together with all its processes* as a "cell," they restrict the term cell to the body or nucleated part alone, and adopt the misleading term "neuron" to designate what is in fact the whole nerve-cell, ignoring the fact that νευρον literally means a sinew or fibre, and if applied

at all in this connection, should be restricted to the nerve-fibre process of the cell, for which they prefer the longer term *neuraxon!* Of course, as every one knows, our authors, in taking this course, are merely following the lead of a certain eminent German anatomist, it being a fashion with American scientific writers (except a few who prefer a sort of scientific Volapük) to follow pretty blindly all German scientific leads in the matter of nomenclature, and this even to the extent of bodily adopting actual German words into a language which can already find two or three synonyms for almost any word it may be desired to translate. No doubt many English authors are also to blame in this respect, but the fact is none the less to be deplored. And how can the average student be expected to understand the homologies of the nerve-cell if he is taught that he is not to call this particular unit a cell, like all the other units in the body, but is to restrict the term to a part of it only, for no other reason than the fact that when we were more steeped in ignorance of the structure of the nervous system than we are at present, that particular part of the nerve-cell was supposed to represent the whole!

Nevertheless, it may be freely admitted, in spite of the above criticisms, that many of the reproductions are extremely well done, and may with advantage be carefully studied by those who have not the opportunity of preparing for themselves specimens of like nature to those depicted. E. A. SCHÄFER.

OUR BOOK SHELF.

Flora der Ostfriesischen Inseln (einschliesslich der Insel Wangeroog). Von Prof. Dr. F. Buchenau. Dritte umgearbeitete Auflage. Small 8vo, pp. 205. (Leipzig: Wilhelm Engelmann, 1896.)

DR. BUCHENAU is well-known as a botanical author for the simplicity and lucidity of his style, and the thoroughness with which he treats his subjects; and this little book is no exception to his usual work. Indeed, it is a model of what a local *Flora* should be, in striking contrast to the bulky barrenness of some of our English county *Floras*. It will easily go into the breast-pocket of a coat, and, as it contains descriptions and other information, it may be used, and be useful, in the field. The flora of the Frisian Islands is, on account of their situation, of great interest; and Dr. Buchenau has worked out its features, composition and peculiarities, with a full appreciation of its interest. An introductory chapter of some twenty-eight pages is a summary of the author's observations on various points; observations which have been published in full elsewhere, to which references are given. The paragraph on sand-binding plants is valuable. With regard to the flora as a whole, two principal points come under consideration, namely, its composition and origin. Taking into account the area, but more especially the slight elevation, the absence of trees, and almost so of shrubs, the flora is a comparatively rich one, and includes a number of species we should hardly expect to find. Dr. Buchenau says that the commonly accepted idea that the most interesting plants of the islands are relatively recent immigrants from the mainland of North-west Germany, will not bear investigation. "The most striking plants of the islands—*Liparis Lœselii, Gymnadenia conopsea, Epipactis latifolia, Parnassia palustris,* &c., are either wanting or exceedingly rare in East Friesland. They are only met with, by degrees, much further south. It is, therefore, inconceivable that they have migrated from the mainland in recent times, and assembled in these islands. The more probable explanation is that these plants are the remains of the old diluvial flora which from various causes have survived in the islands, though they have disappeared from the nearest mainland." I may add that Dr. Buchenau has made a special point of drawing up his descriptions, which are short and clear, from local forms. W. BOTTING HEMSLEY.

A Text-book of Physical Exercises adapted for the Use of Elementary Schools. By Dr. A. H. Carter and Samuel Bott. Pp. x + 168. (Macmillan and Co., Ltd., 1896.)

THIS book calls for notice in NATURE because the exercises in it are founded upon a physiological basis. In a lucid introduction, Dr. Carter deals with "The Physiology of Exercise," and what he says should be read and digested by every teacher who has to do with the physical training of children. A knowledge of the structure and functions of muscular tissue is essential in order to fully appreciate the value of different exercises. For to know the physiological effects of exercise, the cause of fatigue, breathlessness, the nature of muscular stiffness, the reason why rest is necessary for the renewal of reserve force and the relief of muscular pains, is to possess the ability to judge the suitability of this or that exercise for the purpose of physical development.

Physical exercises have been carried out in the schools of the Birmingham School Board for the last ten years, and Mr. Bott, who organised and directs them, has, therefore, had ample opportunity of knowing the practical conditions of the exercises he describes. It is difficult to give clear and practicable instructions for the successful performance of such exercises as those with which the book deals, but, by means of concise text and numerous illustrations, this has been satisfactorily done. These instructions, and Dr. Carter's admirable lesson in physiology, will equip teachers with all they need know in order to carry out a sensible and systematic course of physical training for children.

Der Lichtsinn augenloser Tiere. By Dr. Wilibald A. Nagel. Pp. 120. (Jena: G. Fischer, 1896.)

HALF of this interesting study is taken up by a paper on "Seeing without Eyes," in which the author considers the general question of sensitiveness to light, with illustrations from his own researches. In the second half these researches are described, and some special questions more fully discussed. The author's own observations were made chiefly on lamellibranchs and gasteropods, and showed a high degree of sensitiveness to light in the absence of anything like a visual organ. He found that some molluscs reacted especially to diminution, others to increase of light, and that this difference was correlated with other characters; those molluscs with soft shells, which bury themselves in the sand, reacted strongly to light, while those with hard shells responded more to shade. He found the highest degree of sensitiveness to light in Psammodia; and it is interesting to note, in relation to the common view as to the connection between sensitiveness to light and pigment, that the impregnated siphons of this mollusc were highly sensitive. Another interesting point investigated was the influence of repetition of a light stimulus. An oyster or mussel which has reacted to a shadow will react much less strongly, or not at all, to a second stimulus, even if much more intense, and does not recover its previous degree of excitability till more than an hour has elapsed. The book concludes with a full bibliography.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Utility of Specific Characters.

PROF. LANKESTER (p. 245) has alluded to the dark pigment in the skin of tropical man as "conceivably . . . not in itself a useful, that is, a life-preserving or progeny-ensuring character, but merely the *accompaniment* of a power of resisting malarial germs . . ." residing in the leucocytes. This hypothetical case, used by Prof. Lankester for illustrating his argument, has been seriously entered upon by Mr. Thiselton-Dyer (p. 293), with the conclusion that "it does not follow that epidermal pigment is useless because one explanation of it seems to fail."

I beg permission to call attention to a paper in NATURE, vol. xxx. p. 401, by Surgeon-Major N. Alcock, "Why tropical man is black," which paper has seemed to me of great importance from the time I read it. Ingenuous considerations, together with quotations from various authorities, led Mr. Alcock to the opinion, that the dark pigment of tropical man's skin does serve as a protection against the rays of *light*. Whereas ". . . pigment placed behind a transparent nerve will exalt its vibrations to the highest pitch"—viz. in the eye—". . . the pigment in front of the endangered nerve reduces its vibrations by so much as the interrupted light would have excited, a quantity which . . . would, when multiplied by the whole area of body-surface, represent a total of nervous action that if continued would soon exhaust the individual and degrade the species."

In this way, the blackness of the negro which, as regards *heat* alone, must appear far from protective, will act as a screen against "the twin stimulant of life," light. "May it not, therefore, be claimed that there is much foundation for the suggestion that the black skin of the negro is but the smoked glass through which alone his wide-spread sentient nerve-endings could be enabled to regard the sun?"

There is no lack of evidence in support of this view. I will confine myself to mentioning a letter by Mr. Flinders Petrie (NATURE, vol. xxxiv. p. 76).

Perhaps I may remind the leaders in the old strife about the utility of specific characters, of the remarkable statements in "Descent of Man" (second edition, p. 61), commenting on the important concessions which, in the fifth edition of the "Origin of Species," Darwin has made to the views of Nägeli and others, concerning ". . . the existence of structures, which, as far as we can at present judge, are neither beneficial nor injurious . . ." DAVID WETTERHAN.

Freiburg, Badenia, August 1.

The Position of Science at Oxford.

IN the correspondence which your recent interesting article on this subject has evoked, the writers have mainly applied their criticism to particular aspects of the general argument raised. This is natural, for they have, scarcely without exception, been professionally interested in the teaching and progress of science, and their letters seem to show that an impression exists that there is a cause for blame in the matter, but that there is an uncertainty at whose door this blame should be laid. May I briefly examine the complaints which your original anonymous correspondent brought against the University authorities, and the present system in vogue at Oxford.

The first complaint has reference to the allotment of college scholarships to science. The argument may be admitted that strict justice demands that fifty-five scientific scholarships should be given; that only forty-four science scholars were last year in residence is incorrect. There were at least half-a-dozen men, receiving the emoluments of a nominally mathematical scholarship, who were preparing to take physics as a second school. Then, again, Christ Church annually gives an exhibition of the value of £85. If this be reckoned as equivalent to a scholarship, as in common fairness it should be reckoned, it is perfectly evident that it is not desirable to offer more scholarships in natural science until the school becomes larger, or the competition more severe than is at present the case. It is not unimportant to point out that an examination of the Natural Science Class Lists would show that some of the holders of these emoluments have not justified their selection.

The second part of the indictment against the college authorities is concerned with the appointment (or non-appointment) of science tutors. And in this matter your article is calculated to give a wrong impression, for it should be clearly understood that the college can exercise no compulsory power in choosing a course of study for any commoner. That commoner only can be influenced in this way, who starts his university career with no preference for a particular school, and it is inconceivable that such an one can ever really adorn any branch of study. But the man who knows what he wants to do, will find that he can get all the assistance he requires from his college lecturer, and that he is in no way worse off because the latter is not on the tutorial staff.

Your article contains a comparison between the conditions which obtain at Oxford and Cambridge respectively, much to the disadvantage of the former, and three reasons are given for the fact. First, at Cambridge scholarships are given to men of one year's standing; but if a man has failed to win a scholarship before his second term, it is not easy to see how he will qualify for one after a year's work. The fact that there is no lack of candidates of sufficient merit at Cambridge, is beyond a doubt largely accounted for by the fact that the scholarships are in many cases of smaller monetary value, and a lower standard is consequently expected. Secondly, a greater prestige attaches to the science school at Cambridge; and this is probably the greatest hindrance to an increase in the science school at Oxford. Time alone, by removing this ignorance and prejudice, can overcome the popular idea that science teaching is better, and, it might be added, cheaper in one university than in the other. At any rate, it cannot be said that Oxford collectively has not done her best to remove any inferiority she may have had in the past. The third argument is that the ranks of Oxford undergraduates are mainly recruited from the public schools, that science teaching in public schools is bad, and that the university is responsible. In fact, the essential argument of the article, and the only one that can possibly stand the test of criticism, is that the examination known as "responsions" urgently needs alteration, both in the direction of excluding the compulsory Greek test, and including an examination in the elements of natural science. Such an alteration, it is contended, would improve the science teaching, and it is the duty of the university to effect this reform.

The question of the Greek test is not new, and it cannot be denied that it has been considered and discussed with the utmost deliberation by those who have decided in favour of its retention. It is idle, in the face of facts, to throw a doubt on the sincerity of the University's good will towards science: it is equally impossible to deny, and it is admitted in your article, that the university is perfectly right to demand of its alumni a preliminary "fair general education"; at the same time, it would be difficult to name a body better qualified to decide what is a good general education than Convocation itself. The writer of your article appears to think that the dons—especially the younger dons—are foolish, childish, narrow-minded persons, absolutely ignorant of science and modern languages. This is, fortunately, far from true, and their deliberately expressed opinion, on a point of the greatest importance in public education, is assuredly entitled to some respect. Your correspondent complains that the knowledge of Greek demanded is too small to serve any useful purpose, and some of us may wish that the standard should be raised; but this complaint applies far more aptly to Cambridge than to Oxford. After all, a knowledge of Greek is insisted on because it is the most beautiful, the most expressive language ever written, and it contains the finest literature. A boy may forget how to conjugate a Greek verb (the sneer is rather hackneyed), but the reading of a Greek play, perhaps the most perfect form of literature the artist could use, will still have left a permanent effect on the mind of any one who is capable of culture. Besides, since a proper equivalent for Greek, even if a substitute be possible, will require as much time and as much application in its preparation, it is difficult to see in what way this alternative subject—be it German or any other—will prove more suitable, more convenient, or more congenial.

The question remains of making a knowledge of the elements of natural science compulsory in responsions, for compulsory it must be, if it is to change the existing state of things. The occasion for making this proposal is certainly unfortunate, for it evidently appears to be made not so much as an abstract suggestion for the improvement of education in general, as a scheme for the express purpose of improving the scientific teaching in schools. That it would have even this latter effect is open to

doubt, for mathematical teaching is almost as bad as scientific, although mathematics is compulsory in responsions. But it is clear enough that the proposal can only be defended on the former ground, for it would be preposterous to impose a useless burden on ninety-five per cent. of undergraduates, in order to raise the standard of a particular five per cent. Now, independently of the fact that the "elements of natural science" is a phrase very vague and difficult to define, it may be fairly urged that these "elements" consist of a series of interesting and important facts, of which, however, the connection and interaction is by no means apparent without a fairly comprehensive knowledge. It would be perfectly useless to have a knowledge of natural laws, when the idea of "law" is, in itself, entirely imperfect, as Helmholtz has held it to be in the unmathematical mind. A knowledge of science may be desirable, but equally so is a knowledge of history, or of English law. But if it be expedient to enlarge the scope of responsions in any way, it is abundantly clear that deeper, instead of wider, knowledge should be required: for example, the standard of mathematics might with good reason, perhaps, be raised.

One more remark seems needed in reply to your article. In attributing to the Greeks a true scientific spirit, your correspondent shows a strange and radical misconception of the tendency of Greek philosophic thought. The Hellenic spirit always inclined to speculative and metaphysical, as opposed to experimental philosophy, and Aristotle probably did more to retard our knowledge of natural science than any ten men have ever done to advance it.

The science school at Oxford may, and it is to be hoped will gradually improve, both in size and in quality; especially is there room for hope in the case of the medical school, though it is sadly handicapped by the absence of those opportunities for practical teaching which only a great hospital, situated in a crowded city, can afford. But it is useless to hope that the whole natural science school will ever become very large, so long as the tendency towards devolution and decentralisation in university (which ought to mean the highest) education continues. The principle of centralisation of educational forces, the enormous importance of which seems nowadays to be so lamentably lost sight of, possesses an especial validity in the case of scientific education. If this principle be neglected, it is our own fault if we find, on the one hand, a teaching staff of the highest order without pupils to instruct, and admirably equipped museums and laboratories standing practically idle and in abeyance; and, on the other hand, the best teachers so scattered up and down the country as to hinder the receptive student from gaining the advantages he would otherwise reap from their combined and systematised tuition.

W. E. P.

Liverpool, August 3.

The Mandrake.

IN an anonymous work in Chinese, "Tiau-sieh-lui-pien" (1), nine plants are named as frequently to assume the human or animal figures, viz. cypress, Nan-tree,[1] turnip, mustard, citron, *Pachyma cocos*, *Lycium chinense*, *Phytolacca acinosa*, and *Panax Ginseng*.[2]

Of these nine, doubtless the Ginseng is the plant most celebrated for its medicinal virtues imaginarily connected with its anthropomorphous root (2); but as far as the muitiplicity is in question of the legends talked of analogous to the mandrake-stories, certainly the Shang-luh (*Phytolacca acinosa*) is the most notorious one.

Under the heading at the beginning of this letter, I wrote to NATURE (vol. li. p. 608, April 25, 1895) a note on the analogies between the mandrake- and the Shang-luh-lores, pointing out the two instances, viz.:

(1) The roots of the two plants are said to have human shape.

(2) Both plants are said to have the power of shrieking.

Continuing in the research from that point, I have found further the additional points of analogy, that are as follows:—

[1] Some Japanese botanists (*e.g.* Matsumura, "Nippon Shokubutsu Meii," Tôkyô, 1884. p. 64) identify the Chinese "Nan" with the Euphorbiaceous plant, *Daphniphyllum macropodium*; whether the identity is a sound one, I do not know.

[2] Most plants here enlisted, seem to have the alleged figures in their subterraneous members; only the citron might produce the fruits of such a configuration. As to the named trees, the cypress of Kien-ling was anciently valued for its wood, the veins of which represented naturally angels, clouds, men and animals ("Yuen-kien-lui-han," *op. cit.*, tom. ccccxiii. art. "Peh," 1); whereas the alleged human figure of the "Nan" was apparently formed by its stem and branches (*cf.* H. Ransdell, "Through Siberia," 1882, vol. i. p. 158).

(3) The Shang-luh is said to grow upon the ground beneath which dead man lies; and the mandrake is recorded to thrive under the gallows (3).

(4) When the Shang-luh is about to acquire the power of speech, *ignes fatui*, it is said, crowd about it (4). About the mandrake Richard Folkard remarks: "In an Anglo-Saxon manuscript of the tenth or eleventh century the mandrake is said to shine in the night like a candle. The Arabs call it the Devil's Candle because of this nocturnal shining appearance. . . ." (5)

(5) Chang Urh-Ki, a Chinese literatus of the seventeenth century, writes: "A sorcerer carves the root of Shang-luh into a human effigy, which he makes through his spells capable of telling the fortunes" (6). This forcibly brings to mind the old European belief in the diminutive prophetic images made out of mandrake-root[1] (7).

(6) The mandrake had a reputation that it makes men insane and the reason prisoner (8); correspondingly the red variety of Shang-luh[2] is described by Su Kung (*c.* 656) to be so poisonous as to cause men to see the demons (*i.e.* to make men delirious) (9).

(7) In "Pan-tsau-king," the oldest Chinese authority on materia medica, attributed to the mythical emperor, Shin-Nung, the Shang-luh is mentioned to kill the demoniacal beings; and, later, Teau Hung-King (452–536) speaks of its influence on the "Malignant Worms," which it drives out of the possessed (10), this efficiency being no doubt the principal reason for the Tauist usage of the white Phytolacca under the pseudonym of "Luh-fu" (or "Dried Venison") (11). Still later it is reputed by Ta-Ming (*c.* 968) to purge the "Poison of the *Ku*"[3] (12). Quite conformable to these is the ancient Jewish belief in the exorcising power the herb Baaras (or the mandrake) was renowned to possess (13).

(8) A recipe quoted by Chang Urh-ki from a "Book of Divine Physic" (14) seems to imply the old Chinese usage of the Shang-luh as philtre as much as the mandrake was highly esteemed therefor (15).

(9) "From the remotest antiquity the mandrake was reputed in the East to possess the property of removing sterility; hence Rachel's desire to obtain the plant that Reuben had found. . . ." (16). Now we read in a Chinese herbal that the black, ripe fruit of the Shang-luh is highly valued by rustic women, for it favours their fertility (17).

(10) Of the medicinal properties these plants are known to possess, some are common to both. Matthioli, referring to Galen, speaks as a cooling stuff of the mandrake (18), Li Shi-Chin assigning the same character to the Shang-luh (19). Both herbs were famed for their purgative functions, and both were applied to indolent and scrofulous tumours, and to swellings of the glands (20).

[1] From their traditions, the Chinese appear to have had about the Fung (*Liquidamber Maximowiczii*) two points of analogy to the mandrake-lore. First, Jin Fang's "Shuh-i-ki" (written sixth century, A.D., ed. Wang, tom. ii. fol. 10. *b*) contains the following passage: "In Nan-Chung there is the 'Liquidamber-Elf' (Fung-sze-kwei), which is the old tree of the named species transformed to man in its shape. Second, other authorities say a tumour develops upon the old Liquidamber; after a thunderstorm it elongates to three or five feet in length. Now the sorcerer carves this tumour to a human effigy to play black art thereby in a similar manner to the practice with the Shang-luh. However, in case a proper formula is not observed while gathering it, the tumour flies away and never serves the purpose (*cf.* Ki Ngan, "Nan-fang-tsau-muh-chwang," fourth century, A.D., Brit. Mus. copy, 15255, *a*. 5, tom. ii. fol. 1, *a*; Wu Ki-Siun, *op. cit.*, tom. xxxv. fol. 2 *a*; Sie Tsai-Kang, *op. cit.*, tom. x. fol. 4). Whether related to the latter belief or not, I remember some old men in Japan ever extolling the merits of images of Daikoku, the god of riches, artificially formed out of tumours on *Gingko biloba*.

[2] That is, the variety with its calyx coloured pale rufous. Kan-Pau-Shing, a herbalist of the tenth century, observes of the Shang-luh: "The red flower accompanies the red root and the white flower the white root" (*See* Iinuma, "Sômoku Dzusetsu," new ed., 1874, vol. vii. fol. 89, *b*; Li Shi-Chin, *loc. cit.*)

[3] "The district of Kiang-Nan is much infested by the *Ku*. On the fifth day of the fifth moon, the future keeper of the *Ku* puts together in a vessel a hundred different sorts of animals, varying in size from serpent to louse, which are left therein to mutually devour till but one remains the strongest. This he keeps and feeds in his house as the *Ku*. Whomsoever the keeper wishes to destroy the *Ku* infests in the viscera; consequently the man dies, his treasures passing over to the *Ku*-keeper's house," &c. ("Sui-shu," written seventh century, A.D., quoted in Tsiau Hwang, "Tsiau-shi-pih-shing," Brit. Mus. copy, 15316, *a*, fasc. ii. tom. v. fol. 24, *a*; Ching Tsiau, *op. cit.*, tom. xxxiii. fol. 11, *b*; *cf.* Morrison, "Dictionary of the Chinese Language," London and Macao, 1823. vol. iii. part i. p. 288.) Among the stories pertaining to the *Ku* several incidents occur parallel to those about the mandrake (*cf.* Folkard, *loc. cit.*; Li Shi-Chin, sub. "Kin-tsan"; Kitamura, Kiyû Shôran, new ed., Tôkyô, 1882, tom. viii. fol. 22). Just as are the cases with the mandrake and the Shang-luh, a herb called Lang-tang (*Scopolia* sp. ?) is reputed to make men insane, yet withal to cure demoniacal possession (*cf.* Wu Ki-Siun, *op. cit.*, tom. xxiv. fol. 77, *b.*; Josephus, *loc. cit.*).

So far the many analogies between the mandrake- and the Phytolacca-stories appear to militate against the probability of the independent growths, if not origins, of the folk-lores connected with the two plants.

Further, it may be worthy of notice that, while the ancient Europeans possessed a hazy knowledge of the anthropomorphous Ginseng (21), the Chinese of middle ages had an equally circuitous acquaintance with the mandrake. The fact is well evinced in the following passage of Chau Mih (1232-1308) (22): "Several thousand miles west of the Region of Moslem,[1] the land produces one substance extremely poisonous, which is shaped like man as our Ginseng is. It is called 'Yah-puh-lü,' and grows under the ground several *chang* deep [1 *chang* = 10 Chinese feet]. Should a man bruise its skin, its poison would adhere to and kill him. The only method of gathering it is this: dig around the said substance a hollow deep enough for a man's management therein; with one end of a thong tie up the substance lightly, and with other end bind round a big dog's leg. Now flog the dog; he will, striving to avoid the danger, pluck the substance from the ground, but he will die instantly. The stuff thus procured is buried under other ground, whence it is taken out a year after; then it is dried and prepared with another medicine. When man takes internally a bit of this mixed with wine, it makes him soon fall down unconscious even of cuts and chops; still there is a certain drug which, if used within three days, can recover the man. It is very likely that the celebrated Hwa To [a surgeon who flourished in the third century, A.D.] barely resorted to this drug when, as is traditionally said, he cut open his patients' bellies to cleanse viscela without harm. Presently we learn our Imperial Hospital possesses two pieces of this drug."

The readers of the above passage scarcely need my annotations that the story is obviously composed of what Josephus and Dioscorides record (23), and also that the name "Yah-puh-lü" is nothing but "Ybruh," the Arabic word for the mandrake[2] (24).

References.—(1) In "Hai-shan-sien-kwan-tsung-shu," tom. xlvi. (published 1847), pt. i., fol. 76, *b*; the Imperial Cyclopædia, "Yuen-kien-lui-han," 1701, *passim*. (2) "Encyclopædia Britannica," 9th ed., vol. x p. 605. (3) *Cf.* Folkard, "Plant Lore, Legends, and Lyrics," 1884, p. 427; also my letter in NATURE, *op. cit.* (4) Sie Tsai-Kang, "Wu-tsah-tsu," *c.* 1610, Jap. ed., tom. x., fol. 41, *b*, quoted in my letter, *ubi supra*. (5) Folkard, *l. c.* (6) "Hau-ngan-hien-hwa," Brit. Mus. copy. 15316, *a*, tom. i., fol. 4, *b*. (7) Same as (5) and (8). (8) "Encyc. Brit.", vol. xv. p. 476. (9) and (10) Li Shi-Chin, "Pan-tsau-kang-muh," art. "Shang-luh." (11) Ching Tsiau, "Tung-chi," Brit. Mus. copy, 15281, *a—d*, tom. lxv., fol. 28, *a*. (12) Same as (9). (13) Josephus, "Jewish War," trans. Traill, 1851, book vii. p. 230. (14) Same as (6). (15) and (16) Folkard, *op. cit.* (17) Wu Ki-Siun, "Shih-woh-ming-shih-tu-kau," completed *c.* 1848, ed. Ono, Tôkyô, 1884, tom. xxiv., fol. 16. (18) "I Discorsi, &c.," Venetia, 1568, p. 1136. (19) Same as (9). (20) *Cf.* W. Rhind, "History of the Vegetable Kingdom," 1874, p. 552; same as (8) and (9). (21) *e.g.* Cruden, "A Complete Concordance to the Old and New Testament," 20th ed., p. 436. (22) "Chi-ya-tung-tsah-chau," Brit. Mus. copy, 15316, *a*, tom. i. fol. 41-42. (23) Josephus, *l. c.*; Mart Mathée, "Les six Livres de Pedacion Dioscoride," Lyon, 1559, l. iv., ch. lxv. p. 274. (24) Pickering, "Chronological History of Plants," Boston, 1879, p. 247.

KUMAGUSU MINAKATA.

15 Blithfield Street, Kensington, W., July 16.

P.S.—In writing the present letter, I have not consulted the late Prof. Veth's exhaustive account of the mandrake-stories referred to in NATURE (vol. li. p. 573.) To my great regret it is written in Dutch, a language which is beyond the reach of my understanding. K. M.

[1] In another work by same author, "Kwei-sin-tsah-shih," quoted by Li Shi-Chin, *op. cit.*, sub. "Yah-puh-lü," this herb is said to grow in the "Region of Moslem, north of the Desert," and there it is indicated that the degraded officers of an extreme ignominy used this drug [to feign self-murder]. The Imperial "Yuen-kien-lui-han." *op. cit.*, tom. ccccxi., gives a proverb: "Eat the herb by name Yah-puh-lü; you die, still you are not dead."

[2] Fang I-Chi, the most erudite Chinese of Christian faith, referring to a work of the thirteenth (?) century, "Fang-yu-shing-loh," gives the habitat of the narcotic "Yah-puh-lü-yoh" in the country of Medina ("Tung-ya," 1643, tom. xli., fol. 8, *b*). Conventionally the latter name might be interpreted as the "Drug named Yah-puh-lü," but I am rather inclined to trace it to the name "Yabrochak" used n Palestine for the mandrake (Pickering, *loc. cit.*)

THE ECLIPSE OF THE SUN.

IF it be true that science advances through failures, the clouds which prevented the observation of the total eclipse of the sun last Sunday may be a blessing in disguise. During the past quarter of a century, several astronomers have taken up the problem of discovering a means of photographing the corona in broad daylight, but the results have not been very encouraging. In the photography of solar prominences, Prof. Hale and Dr. Deslandres have obtained distinctly valuable pictures, and, were it possible to delineate the corona with the same success on any day when the sun is shining, our knowledge of the nature of that solar appendage would increase much more rapidly than it can at present, when the only opportunities for studying it are afforded by the brief moments of totality of a solar eclipse. Perhaps last Sunday's experience will induce solar physicists to give further attention to the artificial reproduction of eclipse conditions. It is, of course, not suggested that every-day observations will make eclipse expeditions unnecessary—there will be work for astronomers during solar eclipses for a long time to come—but if it were possible to carry out systematic researches on the structure and constitution of the solar surroundings, instead of depending entirely upon the rare intervals when the photosphere is obscured, several moot points might be settled before the end of this century.

Observations of the total eclipse of Sunday last were made impossible by clouds. From all along the line of observers, the same report of foiled intentions has been received. At Vadsö, and in the neighbourhood, the sun was entirely obscured during totality, and no observations of scientific importance were obtained. The party of Russian astronomers who stationed themselves at the village of Orloffskoe, on the Amur, were equally unsuccessful in making observations. The eclipse was visible as a partial eclipse at Tokio, but at Akeshi, in the island of Yezo, where the Japanese, American, and British observers had set up their instruments, the weather was wet and the sky cloudy, and it is reported that the preparations made ended in a fiasco. It is not definitely known what happened at Esashi, where Prof. Todd and Dr. Deslandres were stationed, but little hope of success is entertained. A telegram received at Copenhagen from Bodö, Norway, states that a photographer from Flensburg has taken eleven photographs of the eclipse at Bredvik, on the Skjerstad Fiord, but more details are needed before an opinion can be expressed as to their value. News has yet to be received from the British observing party at Nova Zembla, and from the expeditions of the Russian Astronomical Society stationed at Enontekis (Finland), the mouth of the Obi, and Olekminsk, on the Lena.

Mr. Norman Lockyer has sent us the following telegram from Kiö Island, where he established a station to observe the eclipse: "Although the sun was clouded during totality, the sight was most impressive. The darkness was so great that lamps were needed. The party from H.M.S. *Volage* consisted of seventy-seven observers all trained to make notes or drawings of particular characteristics of eclipse phenomena, such as coronal structure, extent of the corona, and the colours of sky, cloud, and land and water surfaces, and to take the times of contact. The party was also provided with spectroscopes for analysing the lights of the corona and prominences, prismatic cameras for photographing the spectra of these objects, and polariscopes." With such an army of organised observers, an immense amount of valuable information would have been accumulated had the eclipse been visible. The exceptional opportunities for accurate observation offered by the presence of the Training Squadron gives astronomers reason for keen disappointment at the failure of the eclipse as an observable event; but students of science are used to the

destruction of their hopes, and the next total solar eclipse will be as eagerly looked forward to as the one just hidden from them.

An interesting description of the scene in the neighbourhood of Vadsö appeared in Tuesday's *Times*, and the following is an abridgement of it.

On Sunday morning the Varanger Fiord in the north-east of Norway presented a scene which has probably never before been equalled in a latitude of 70°. The anchorage at the port of Vadsö was crowded with men-of-war, yachts, and passenger steamers, brought together by reason of the total solar eclipse. For several days the numerous astronomers on these ships have been engaged in landing their delicate and elaborate instruments, and transporting them to the beautiful sites which here abound.

By last night the laborious preparations of the different observing parties had been completed, and they awaited with what composure they might the momentous events of the morrow. In any circumstances an Arctic summer night, where broad daylight reigns throughout, is very different from a night in a temperate region. But on this occasion there were so many interruptions, partly by the arrival of friends in the various ships, that rest was but little thought of, and indeed from two to five and even earlier a succession of boats brought hundreds of passengers from the ships to the shore.

The fence which marked out the ground occupied by the observers was guarded by bluejackets, charged with the duty of keeping at a suitable distance the groups of picturesquely-clad Finns and Lapps, who gazed with astonishment on the strangers who had travelled so far, and on the wonderful appliances they had brought with them. Many of these Arctic inhabitants were, however, sufficiently sophisticated to be provided with the traditional pieces of smoked glass with which to make their own observations.

The sun could not be seen at the moment when the moon first made contact, though almost immediately afterwards it was visible with a slight encroachment on the brilliant edge, showing that the eclipse had commenced. For nearly an hour hope and fear then alternated. Everything, of course, depended on the condition of the sky at the moment of totality, and it was hoped that some of the characteristic phenomena of a total eclipse might be presented. This hope was strengthened as the crescent sun waned thinner and thinner and still remained visible.

As the supreme moment of totality approached, the broad landscape sensibly darkened, and the fiord became more gloomy. It was as if some mighty thunder-shower was about to descend; but, alas! the clouds again thickened, and the observation of the moment of actual totality, if effective at all, could only be made by glimpses with a telescope through a very dense medium. Some observers were, of course, constrained to limit their attention to their instruments, and to the sole discharge of the duties which had been entrusted to them. But many were in the position of being able to look at the sun until the crescent of light was about to disappear, and then face round to the opposite point of the horizon. The object of this manœuvre was to permit the observer to see the impressive spectacle of the advance of the lunar shadow over the earth.

The situation at Vadsö lent itself admirably to the observation of this magnificent phenomenon. As the shadow advanced across the fiord, it enveloped the training squadron as it lay at anchor, the details of the ships' rigging disappeared from view, and their lights gleamed forth brilliantly. Still the shadow pressed on with its majestic speed of a mile in every couple of seconds. It moved as swiftly as a cannon-ball until it reached the observers at Vadsö, and then announced to them in the most impressive manner that the supreme moment of their visit had arrived, and that totality was complete.

The darkness that then buried Vadsö and its numerous observers lasted for a minute and forty seconds. The unwonted spectacle hushed every one to silence. A few startled birds hurried past the camp, and amid the canopy of cloud which covered the heavens at least one observer descried a star. But, though all the visitors felt that the magnificent phenomena were worthy of being remembered as a life-long experience, yet it is none the less true that, from a scientific point of view, the result of all the labours at Vadsö was hardly anything.

The object of the astronomers, who erected at such vast pains great photographic instruments, was to depict the corona and to analyse with spectroscopes the light which it dispenses. It is true that during the time of totality they exposed their plates in accordance with the careful drill and organisation which were indispensable if full advantage was to be taken of the brief period. But, unfortunately, during the time of totality the clouds were obdurate, and nothing could be seen. The innumerable telescopes directed to the sun showed no more than the same instruments would have done if they remained still covered.

The 100 seconds fled, marked only by the mechanical precision of the officer who counted them aloud. The astronomers might safely spare glances to the interesting view over land and sea. The light around them was not greater than that during a full moon, but in the distance mountain-tops could be descried which were not in the shadow and were shining brilliantly.

At last the darkness lifted, and the manner in which the light returned was almost startling in its suddenness. It was not that the sun became visible—this, indeed, did not at first happen—but when the moon had passed by, and when totality was over, the sun illumined the clouds, and this gave again the usual light of cloudy day when the orb itself is invisible. A few seconds later a glimpse was afforded of the crescent form of the sun, and then the clouds closed in once more, and did not withdraw until long after the moon had passed away from the disc.

THE PHYSICAL LABORATORY AT LEIDEN (HOLLAND).

WHEN a few years ago it appeared advisable to Prof Kamerlingh Onnes, the Director of the Physical Laboratory at the University of Leiden, to start the issue of a periodical paper which would contain a regular account of the research work that was going on in his laboratory, he decided upon the English language as being for various reasons the most suitable for the purpose. The "Communications from the Physical Laboratory at the University of Leiden" consist, as a rule, of more or less happy translations of contributions by Prof. Onnes and his pupils to the *Proceedings* of the "Koninklijke Akademie" of Amsterdam. They give short accounts of the researches that are carried out, and contain theoretical notes, as a rule, in direct connection with the experimental work. The full accounts of the investigations are mostly to be found elsewhere in various French, German or English periodicals.[1] No. 23 of the series appeared lately, and the whole set, containing everything that has been done in the laboratory since 1885, is now complete.

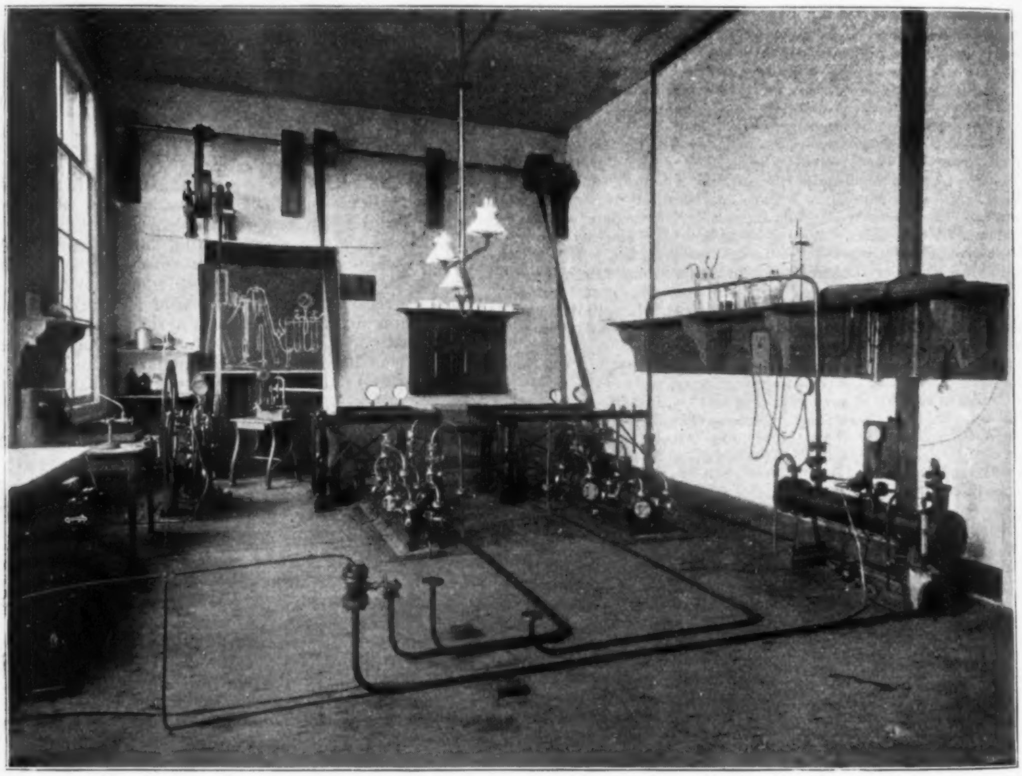
The most important characteristic which distinguishes the Leiden laboratory from most of its contemporaries is its installation for high-pressure and low temperature work. There are probably only one or two more places where an installation of this kind is permanently joined to a well-provided physical laboratory. Nos. 14 and 23 (especially the former) give a general idea of its gradual development and present arrangement.

Ever since 1883 Prof. Onnes has been working at this department. His object was in the first place to develop and improve the methods introduced by Cailletet, Pictet, Wroblewski, Olszewski, and to prepare larger quantities of liquid oxygen than before, so as to be able to decant it and use it as a cooling agent for experiments, especially on the liquefaction of hydrogen. The same object was, during the same years, striven after by Pictet, Olszewski and, in this country, by Dewar. Owing to want of sufficient funds and personal assistance, the work progressed very slowly, and it was not till June 1892, that a small quantity of liquid oxygen was decanted, while in December 1893 half a litre was obtained. It is interesting to notice how entirely independent the Leiden work is from the others. In the first place, Prof. Onnes uses Pictet's cycle method, while Olszewski developed the method used by Wroblewski in conjunction with himself. Instead of sulphurous acid, used by Pictet, he introduced methylchloride in the first cycle (a suggestion of Cailletet's), while ethylene remained

1 *Archives Néerlandaises, Wiedemann's Annalen, Beiblätter, Zeitschrift für Physikalische Chemie, Philosophical Magazine.*

the second substance. Both substances are in continual circulation in metallic, self-contained cycles, which are worked by two Pictet conjugated pumps. While Olszewski introduced a steel cyclinder in which to liquefy oxygen, Prof. Onnes devised an "ethylene boiling flask" in which oxygen (or air) is condensed in a copper spiral. The glass apparatus into which the oxygen is poured is of original construction, and especially adapted for experimental work in oxygen (or air) baths of $\frac{1}{4}$ to $\frac{1}{2}$ litre.

Sometimes instead of the methylchloride cycle solid carbonic acid is used. Experiments on the insertion of a methane cycle between the ethylene and oxygen, with the ultimate object of condensing hydrogen, are still being carried on. Oxygen and air are taken from high-pressure cylinders, into which they are compressed either by a Brotherhood compressor (as used in launching torpedos) into a kind of model "cryogenic laboratory," as Prof. Onnes calls his creation, with emphasis on both cryogenic and laboratory. Occasional comparisons with other cryogenic installations illustrate this vividly. Dewar works with quantities of ethylene up to "a hundredweight" (40 kg.), while Prof. Onnes requires 1·5 kg., by aid of which $\frac{1}{4}$ to $\frac{1}{2}$ litre of oxygen is kept liquid. Pictet estimates the power required for experiments with liquid air at from 30 to 40 h.p., while in the Leiden laboratory only six or eight are required, even in exceptional cases. Olszewski gives his power as 1–3 h.p., but it must not be forgotten that his system is not a continuous one, and that the largest quantity which his apparatus in its enlarged form yields is 200 cc., only $\frac{1}{3}$ of which gets into his boiling-glass. His experiments require a correspondingly smaller quantity of ethylene (1 kg.).



View of the cryogenic department in 1887, showing the compressors destined for the chlormethyl, ethylene, and oxygen cycle. At the right the chlormethyl condenser.

or by a much less powerful, but in other respects highly superior Cailletet compressor. This compressor as modified, almost re-designed by Prof. Onnes, is a most desirable laboratory apparatus where high-pressure work with pure gases is being done. The chief modification is that the mercury column works in a steel U-tube, so that the piston with its lubricant (glycerine) is on one side above it, and the valves, &c., on the other. This compressor may be fully depended upon; the gases remain just as pure as they were, and may be compressed to 100 atmospheres without loss. (A full description of this compressor may shortly be expected.)

It is worth noticing that the greatest possible care is taken (and had to be taken) in the way of safety and of economy; these circumstances make the department

It need hardly be said that these low figures have only been arrived at by a slow process of trial and gradual improvement, and one cannot but admire the perseverance and skill which the development of this system reveals.

Now that the cryogenic department is so far completed that baths of liquid oxygen and air may be readily prepared, no doubt the co-operation with the rest of the laboratory will become more regular and fruitful. Even now, in reading through the "Communications," we come repeatedly across instances in which the high-pressure and low temperature appliances have given invaluable help.

At one time, for instance, pure oxygen was required for experiments on the magnetic rotation in gases at high pressure (Nos. 7, 15). Commercial oxygen being too

impure for the purpose, the preparation of a cubic metre of oxygen was undertaken. The gas was prepared by electrolysis, conducted through purifying apparatus, and compressed into a steel cyclinder of 10 litres capacity, at a pressure of 100 atmospheres by the mercury compressor. The gas in the cylinder appeared to contain nearly 99 per cent. of oxygen. How many laboratories exist in which such a thing could be performed?

As to low temperatures, in No. 6 we notice the measurement of the capillary elevation of ether at -102° in boiling ethylene; in No. 18, of the same magnitude for carbonic acid and nitrous oxide at -24° in boiling methylchloride. Nos. 4, 16, 18 contain the description of a method for purifying gases by condensation and fractional distillation at low temperature, in a bath of ethylene or in solid carbonic acid, the gases purified being carbonic acid, methylchloride, nitrous oxide, and ethane. Finally, we may note the measurement of the viscosity of methylchloride at -30° in cooled alcohol.

The different investigations hitherto carried out may be arranged under the following headings.

I. Cryogenic department: condensation of methane, isothermals of hydrogen at low temperatures, &c. (Nos. 14, 23.)

II. Investigations regarding critical points and condensation of mixtures and of pure substances. (Dr. Kuenen. Nos. 4, 7, 8, 11, 13, 16, 17.)

III. Measurements on the capillarity of ether, carbonic acid, nitrous oxide, &c. (Drs. de Vries and Verschaffelt. Nos. 6, 18.)

IV. Measurements on the viscosity of methylchloride in connection with the laws of corresponding states of matter. (Drs. Stoel and de Haas. Nos. 2, 12.)

V. Series of experiments on Kerr's magneto-optical phenomenon, &c. (Drs. Sissingh, Wind and Zeeman. Nos. 1, 3, 5, 8, 9, 10, 15, 20.)

VI. Some experiments regarding Hall's phenomenon in bismuth. (Dr. Lebret. Nos. 15, 19.)

VII. On Hertz-waves in water and in electrolytes. (Dr. Zeeman, partly in conjunction with Prof. Cohn, Strassburg. Nos. 21, 22.)

VIII. Observations on the dispersion of magnetic rotation in gases. (Dr. Siertsema. Nos. 7, 15.)

The scope of this article does not allow of a further description or discussion of any of the above investigations. One instance will show the scale on which the experiments are carried on, if deemed necessary. For the observations mentioned under VIII., two coils were constructed, each of 1 metre length and with 3600 turns of 6 mm. wire, the joint resistance of the coils in series being 1 ohm, and the current carried 70 amperes.

Besides a dynamo there are two or three sets of accumulators, which make it possible to work simultaneously at two or three investigations for which strong currents and electric lamps are required. In short, the place is rich in apparatus of all kinds, and possesses numerous appliances; so much so, that one would rank it amongst the best provided (and, one may add, most productive) research laboratories. It is worth observing, that in Holland private munificence is hardly ever directed towards scientific work, and that the whole of this laboratory, as of all the others in the three Government Universities—Leiden, Utrecht, Groningen—are kept up from the public purse. It is only recently that, under the strain of the competition between the Universities, private societies have been founded to promote University work, where the Government shows itself unwilling or unable to provide the necessary means.

Those to whom these "Communications" are unknown, and who are desirous of becoming more intimately acquainted with their contents, have only to apply for copies to receive them. Prof. Onnes will, moreover, be very glad if physicists, touring in Holland, would alight at the famous University town, and in their programme include a visit to his laboratory.

THE GREAT RIFT VALLEY.[1]

It is but rarely that a narrative of travel, however interesting it may be, and however exciting the adventures of the author may have proved, has as much attraction for naturalists and geologists as the present volume possesses. Dr. Gregory has shown himself a thoroughly competent explorer, for he succeeded in reaching the glaciers close to the summit of Mount Kenya, the highest peak of British East Africa, a task in which several previous travellers had failed; and he also examined a considerable length of the extraordinary tract that gives its name to the book before us. This, too, was accomplished with a much smaller caravan than was regarded by experienced men as necessary for safety; in face of difficulties, due to the proclivities of the natives and to scarcity of food, that would have daunted many men; in spite of the utter failure of the expedition to which the author was originally attached; and, above all, despite severe attacks of malarial fever and dysentery. "The Great Rift Valley," apart from its scientific interest, gives a very interesting account of an adventurous exploit, carried out with courage and firmness, and, at the same time, with kindly treatment of the natives employed and encountered.

It is, however, not as a record of exploration alone that this book needs notice. Explorers equal to Dr. Gregory in courage and tact, and perhaps superior to him in the power of resisting malarial influences, have made their way through many of the forests and deserts of Africa, and have told some of the secrets of the Dark Continent to an appreciative audience; but very few of those who returned to tell the tale of their adventures possessed the scientific training that gives an especial value to Dr. Gregory's account of his travels. In this respect the author of the present work is singularly qualified. In the era of specialisation in science that we have now entered upon, it is becoming rare to find a geologist who knows anything of zoology or botany, or a zoologist or botanist who can tell schist from shale or sandstone from granite; whilst it appears to be rapidly becoming a point almost of honour with the geologists, zoologists, and botanists of the British Islands to regard palæontology as an inferior science. It is therefore noteworthy that Dr. Gregory, who is a palæontologist, should have brought back from Eastern Africa a mass of observations that could not have been accumulated by a geologist ignorant of biology, nor by a zoologist or botanist unacquainted with geology.

Briefly the history of the journey described is this. In November 1892, Dr. Gregory received leave of absence from the Trustees of the British Museum to enable him to join an expedition to Lake Rudolf. From various causes this expedition was a failure. After the dispersal of its members, Dr. Gregory went on to Mombasa, where he engaged a small party of porters, and in March 1893 started for Lake Baringo and Mount Kenya, and succeeded in reaching both. The journey occupied five months, and the expedition returned to Mombasa in August.

The arrangement of the present work is the following. After an introduction, giving a general account of previous exploration, and of the geology of the area as known before the author's visit, the first three chapters relate his experience with the abortive expedition which started from Lamu to explore Lake Rudolf and the regions between that lake and the Red Sea, but never got beyond the lower reaches of the Tana River; then eight chapters contain a description of the journey to Baringo and Kenya; and the third part of the book, comprising

1 "The Great Rift Valley: being the Narrative of a Journey to Mount Kenya and Lake Baringo, with some Account of the Geology, Natural History, Anthropology, and Future Prospects of British East Africa." By J. W. Gregory, D.Sc., F.G.S., F.R.G.S., F.Z.S., of the British Museum (Natural History). (London: John Murray, 1896.)

seven chapters and three appendices, affords a general summary of the scientific results.

The "Great Rift Valley," of which the characters were first indicated by Suess, is a fissure in the earth's surface into which, or into portions of which, a strip of the surface itself has been let down by parallel faults. The cliffs formed by the faults have not been removed by denudation, and the necessary inference is that the dislocation—partially, at all events—is of small geological antiquity. The great fissure itself is regarded as similar in character to certain lines, resembling cracks, that have been observed on the moon's surface; it has been traced at intervals from the valley of the Zambesi to Lake Rudolf, and it is supposed to be connected through the trough of the Red Sea with the depression containing the Jordan Valley and the Dead Sea in Palestine. From Lake Rudolf a branch rift appears to diverge to the west, and to lead through Lakes Albert and Albert Edward to Tanganyika; whilst south of Lake Rudolf the eastern branch, our knowledge of which has been materially increased by Dr. Gregory's examination, contains several smaller lakes—Baringo and Naivasha, amongst others—and probably terminates to the southward in Lake Nyassa. Altogether this wonderful north and south trough is regarded as having a length of 4000 miles, and is said to contain thirty lakes, of which only one has an outlet to the sea. Evidently only the eastern branch of the rift is referred to, fo :three large lakes in the western branch—the Lakes Albert, Albert Edward, and Tanganyika are drained by the Nile or the Congo.

The principal additions to our knowledge of the "Great Rift Valley" are two in number. Dr. Gregory has shown, apparently beyond any chance of error, that the portion of the valley examined by him—fifty to seventy miles on each side of the equator, or about 120 miles in all—is actually let down by faults on each side. He has also shown that great changes in elevation must have occurred throughout the area in comparatively recent geological times, and that one of these led to the formation of a large lake, of which traces are left in the form of terraces on some of the scarps that bound the Rift Valley. To the ancient lake Dr. Gregory applies the name of Lake Suess; and, if a name is required, no more appropriate one could be devised.

The discoveries on Kenya were even more important than those in the Rift Valley, for not only did Dr. Gregory find glaciers, but he met with clear evidence that these glaciers formerly descended more than 5000 feet lower down the mountain than they now do. Reasons are given—one of the most important being the absence of any similar evidence on Kilimanjaro—for doubting whether the former extension of glacial action on Kenya was due to a general refrigeration of the earth's surface in the glacial epoch, and it is inferred that Kenya and the surrounding area have undergone depression since the period of maximum glaciation on the mountain. This may be the case, but it leaves the great difficulty of the whole question unexplained; we have still to account for the isolated occurrence of temperate plants, both of northern and southern types, on all the Central African mountains.

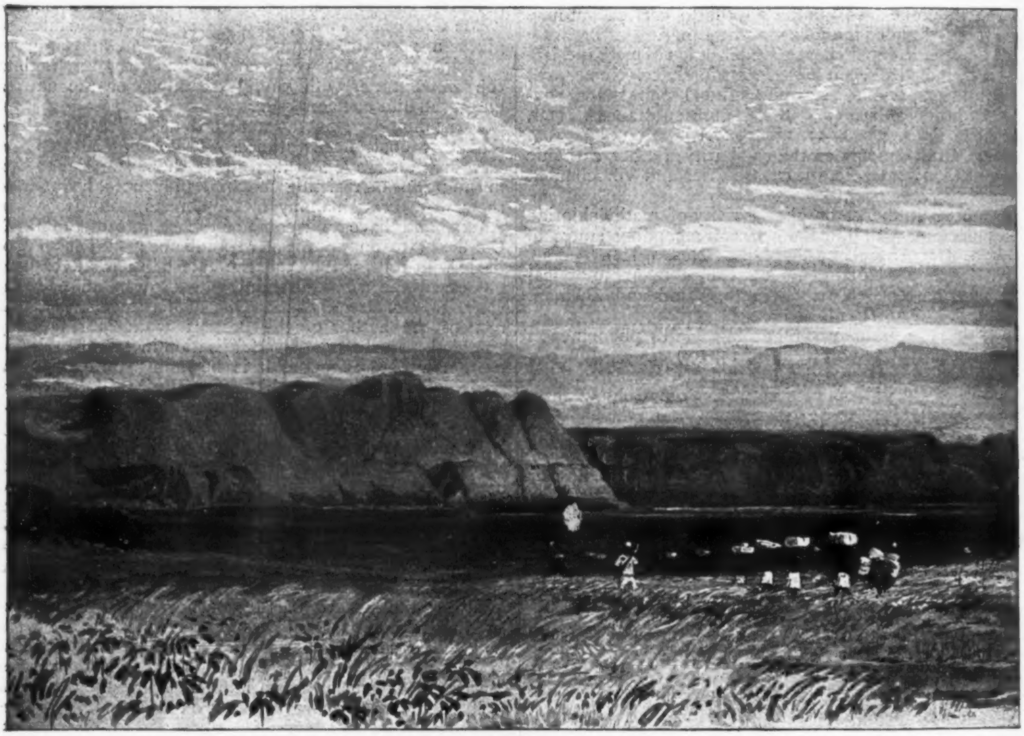


Fig. 1.—The Eastern Wall of the Rift Valley, with the Terraces of Lake Suess.

A considerable mass of interesting details on the geology of the country lying between the coast and the Rift Valley is given, and incidentally, with reference to the great lava plains traversed, their origin is discussed and a theory put forward to account for the phenomena.

It may, however, be doubted whether this theory, which its author terms that of plateau eruption, is really different from the explanation of the so-called fissure eruptions given in Sir A. Geikie's text-book.

It is when we pass from the purely geological chapters to those portions of the work that refer to the East African fauna and flora, and to the descriptions of the various tribes who inhabit the country, that we come to what will probably prove to many readers the most attractive portion of Dr. Gregory's work. The pages relating to the present and past distribution of life teem with original suggestions, and many of the observations made on the journey are highly novel and interesting. Amongst these are some curious cases of mimicry, especially that represented in the frontispiece to the volume, in which a group of hemipterous insects, red and green, presents an astonishing similarity to a flower-spike. Remarkable examples are given of the disappearance of wild animals, such as buffaloes and giraffes, throughout a very large tract of country, in consequence of disease; whilst observed instances of the destruction of great numbers by drought, and the accumulation of their skeletons around isolated water-holes, are suggested as perhaps accounting for some of the enormous masses of mammalian bones that are found imbedded in particular strata. It is not necessary to agree with suggestions of this kind in order to recognise their value; and unquestionably under the conditions pointed out, if the bones are, soon after the death of the animal, enclosed in silt or gravel, they may be preserved. Bones exposed on the surface, however, especially in the tropics, decay and break up with great rapidity, and the accumulations of fossil bones occasionally found are more probably due to carcases, carried down by a river flood, having collected in a backwater or on a sandbank.

One example of a suggestion of the author's, peculiarly illustrative of his double range of investigation, as geologist and as biologist, may here be noticed. It has long been known—we are indebted to Dr. Günther for the original facts—that the fresh water fish-fauna of the Jordan and Sea of Galilee resembles in certain peculiarities, such as the presence of the genus *Hemichromis*, that of the Central African lakes more than that of Northern Africa and of the lower Nile basin. Dr. Gregory shows the possibility of the Red Sea depression having once been the valley of a river flowing into the Indian Ocean, and receiving near its mouth a tributary from the large lakes that formerly existed in the Rift Valley, and that may have occupied a considerable portion of what is now the upper Nile basin. This is of course, as is fully admitted, hypothesis, but it is supported by a very curious mass of data, and it explains the difficulties better than any other suggestion hitherto put forward.

One characteristic of Dr. Gregory is a taste for naming various things, past and present. In many cases this is useful, as when he maps and names the ridges and valleys of Mount Kenya. It may also be of service to have a name, like Lake Suess, for an ancient sheet of water of which evident traces remain; but it is somewhat questionable whether there is any advantage in calling the hypothetical stream, that may at some past time have traversed the Red Sea, the Erythræan river. In one case the author of the "Great Rift Valley" appears, in

FIG. 2.—Two Wa-pokomo of the Tana.

the application of names, to have departed from the usual practice. Geologists have generally given local names to rock-systems and their divisions, and have referred them, so far as they were able, to the geological periods, or divisions of geological time, recognised in Europe. To judge by the table at p. 235, certain names—Naivashan, Laikipian, &c. —are given to divisions of geological time rather than to rock-masses, and it is fairly open to grave

doubt whether this is an improvement on the usual practice.

The chapters on the flora of East Africa, and those on the Zanzibari and other natives of the country, contain a large amount of information, and are thoroughly readable. The same may be said of the concluding chapter on the national movements and future prospects of British East Africa. The whole book is clearly and well written and liberally illustrated, and the author, who quotes—and quotes appositely—not only Shakespeare, Byron and Göethe, but also Carlyle, Buckle, and Rudyard Kipling, has evidently gleaned widely in literary as well as in scientific fields. W. T. BLANFORD.

THE MEETING OF THE INTERNATIONAL COMMITTEE OF THE CARTE DU CIEL.[1]

AT the fourth meeting of the International Committee of the Carte du Ciel, which took place at the Paris Observatory in May, under the presidency of M. Tisserand, the following members were present: MM. Anguiano, Bailland, Bakhuyzen, Christie, Donner, Duner, Gill, Henry (Paul), Henry (Prosper), Loewy, Rayet, Ricco, Trépied, Turner, Viniegra. There were also present at the invitation of the Permanent Committee, MM. Abney, Backlund, Bouguet de la Grye, Callandreau, Common, Cornu, Downing, Fabre, Faye, Gautier (P.), Jacoby, Knobel, Laïs, Laussedat, Newcomb, Perrotin, Scheiner, Stephan, Wolf.

Of the eighteen observatories associated for the production of the Carte du Ciel, thirteen were represented. The directors of the five other observatories, MM. Russell (Sydney), Baracchi (Melbourne), Obrecht (Santiago), Cruls (Rio Janeiro), Beuf (La Plata), were prevented from attending by great distance or by professional duties.

The following officers were elected: President, M. Tisserand; Vice-Presidents, MM. Bakhuyzen and Gill; Secretaries, MM. Donner and Trépied.

The following resolutions were adopted:—

I.—Photographic Catalogue.

1. The Committee is of opinion that the probable error of the value of the rectilinear coordinates measured on the plates should be reduced to the smallest possible limits, and that the measurements must be directed in such a way that this probable error shall never exceed $0''\cdot20$.

2. (*a*) The Committee thinks it necessary to publish the rectilinear coordinates of the photographed stars as soon as possible.

(*b*) It is desirable that this publication should include the necessary information for the conversion of the results into equatorial coordinates.

(*c*) The Committee desires that a provisional catalogue of right ascensions and declinations should be published by those observatories which have sufficient funds at their disposal.

3. Each observatory will be at liberty to choose the positions of the comparison stars in the catalogues which seem to them most suitable. For the calculation of the constants of a plate, a minimum of ten comparison stars should be adopted if possible. The adopted positions of these comparison stars will be published.

4. The question of determining whether, for the reduction of the stars to 1900, it would be advisable to adopt a uniform system of constants for the observatories, will be the subject of a subsequent discussion.

5. The Committee recommends the adoption of a uniform size of publication for all the observatories; the size should be that of the volumes of the Catalogue of the Paris Observatory.

[1] Abridged from the *Bulletin Astronomique*, July 1896.

6. The observatories will be at liberty to determine the photographic magnitudes, either by measurements or by estimation. The only condition which the Committee thinks it necessary to impose, is that the system of photographic magnitudes on which the measures or estimations depend, should allow of a precise definition, so that the different scales used in the different observatories can be reduced to a common system.

II.—The Photographic Chart.

7. Every observatory will be provided with a scale of density, which will be printed on the plates at the same time as the *réseau*, and which will permit the determination of the sensibility of each plate for luminous sources of different intensities.

Captain Abney is charged by the Committee with the construction of the scales.

8. For the construction of the chart, the second series of negatives (that is to say, those of which the centres have odd numbers for their declinations) will be made in three exposures, each lasting thirty minutes. This time of exposure may, of course, be reduced if an increase of the sensibility of the photographic plates be secured.

9. The Committee allows photogravure on copper as a means of reproducing the chart. The negatives to be exposed three times, and enlarged to twice the original size.

10. The observatories will make two positives on glass by contact, one of which will be placed in the Pavillon de Breteuil, the headquarters of the International Bureau of Weights and Measures.

11. The Committee defers till the next meeting the examination of the measures which it may be necessary to take with the object of assisting those observatories which may anticipate a difficulty in completing their programme.

The meetings of the Committee were marked with the greatest cordiality, and with the desire to carry to the end the great work undertaken in common; the decisions, prepared by special sub-Committees, were passed unanimously by the members present.

The Conference was followed by a soirée on Saturday, May 16, and by a dinner given the next day (Sunday, May 17), in the large gallery of the Observatory, at which the following were present: MM. Rambaud, Minister of Public Instruction; Bertrand and Berthelot, Permanent Secretaries of the Academy of Sciences; Cornu and Chatin, President and Vice-President of the Academy; the members of the Committee, and numerous visitors belonging to the Academy, the Bureau des Longitudes, the Council of the Observatory, and the *personnel* of the establishment. Prof. Backlund, Dr. Downing, and Prof. Newcomb, members of the Conference on fundamental stars, were also present.

NOTES.

LIEUTENANT DE GERLACHE announces that the Belgian Antarctic Expedition he has been organising for some time past will not be sufficiently advanced to start before next year.

M. EUGÈNE TISSERAND will shortly retire from the post of Director-General of Agriculture in France, after forty-six years of public service.

EXTREMELY hot weather is reported from North America. In New York, on Tuesday, the shade temperature reached 97° F. As many as 226 deaths are recorded as being directly due to this abnormally high temperature. In Chicago there were fifty-one deaths on Monday, and twenty-five on Tuesday. Hundreds of dead horses are said to be lying in the streets. The thermometer registered 96° F. at Ottawa.

THE deaths are announced of Dr. Kanitz, Professor of Botany in Klausenberg University, and Dr. Simony, formerly Professor of Physiography at Vienna.

OWING to a doubt having arisen as to whether the publication of *Climate and Health* was authorised by the Act appropriating to the U.S. Department of Agriculture the grant for the fiscal year ending June 30, 1897, that valuable repertory of statistical and other information relating to climatology and its connection with hygiene, has had to be discontinued. The special papers intended for it will be published in separate bulletins.

THE opticians of Pennsylvania are endeavouring to form a State organisation, having for its objects, first, the elevation and advancement of the profession and the mutual intercourse and benefit of its members; second, to encourage opticians to perfect themselves in the study of optics and the scientific adaptation of lenses in correcting errors of refraction; and, third, to discourage the haphazard and indiscriminate sale of spectacles by irresponsible and ignorant persons. British opticians might with advantage follow the lead of their Transatlantic brethren.

THE fifteenth Congress of the Sanitary Institute will be held at Newcastle-upon-Tyne, from September 2 to September 9. An inaugural address will be delivered by Earl Percy, and lectures will be given by Dr. A. Wynter Blyth and Sir Charles A. Cameron. The Sections and their Presidents are: (1) Sanitary Science and Preventive Medicine; President, Prof. W. H. Corfield. (2) Engineering and Architecture; President, Sir Andrew Noble. (3) Chemistry, Meteorology, and Geology; President, W. H. Dines. There will be conferences of port sanitary authorities, medical officers of health, municipal and county engineers, sanitary inspectors, and on domestic hygiene. Excursions and visits to places of interest will be made during the Congress, and particulars with reference to them will shortly be made known. The Health Exhibition, held in connection with the Congress, will be opened by the Duke of Cambridge.

THE summer meeting of the Institution of Junior Engineers will be opened on Saturday at Edinburgh. After visiting the Forth Bridge and a number of industrial works, the members will leave on Tuesday next for Glasgow, where many places of engineering interest await their inspection. In the afternoon of the same day the members will be received in the Municipal Buildings by the Lord Provost and the Corporation, afterwards being entertained to an excursion to visit one of the new reservoirs of the Glasgow Corporation Water Works. On Wednesday there will be an excursion to Dumbarton, and a reception by the Provost and Town Council. An excursion will take place on Thursday; and on Friday various works will be open for visiting, the selection being left with the members. In the evening of Friday, the Institution's summer dinner will be held at the Alexandra Hotel, Glasgow, the President, Mr. Archibald Denny, in the chair, and Lord Kelvin the guest of the evening.

IN the *Bulletin* of the University of Wisconsin (Engineering Series, vol. i. No. 9), Mr. G. A. Gerdtzen discusses in a very complete manner the relative advantages of gas, steam, and electricity for the supply of heat, light, and power for domestic purposes. Electricity gives a perfect solution of the problem considered apart from expense, but practically it is out of the question for heating purposes. Although most of the European work on the subject is mentioned and discussed, the chief interest of the paper lies in the details of American practice. Stress is laid by the author on the altered conditions due to the extensive introduction of incandescent gas-burners.

THE following are among the exhibitions at present open, or which will be opened in various parts of the world before the end of the century. 1896: Odessa, Industrial and Fine Arts; Prague, International Pharmaceutical; Cannes, International; Rouen, National and Colonial; Geneva, National; Berlin, Industrial; Kiel, Maritime and Fisheries; Mexico, International; Exhibition at Para; Exhibition at Johannesburg; New York, Electric; Barcelona, Industrial Arts; Denver (Colorado), International Mining and Industrial; Vienna, Agricultural Machinery; Nijni-Novgorod, National; Innsbruck, Hygienic; Lyons, Exhibition of Natural Hygiene; London, Motors and Automatic Carriages. 1897: Brussels, International; Hamburg, International Horticultural; Rio Janeiro Exhibition; Guatemala, Central American; Exhibition at Brisbane; Exhibition at Stockholm; Montreal, International; Nashville (Tennessee), International Industrial and Fine Arts. 1898: Amsterdam, Universal; Exhibition at St. Paul, Brazil; Exhibition at Turin. 1899: Exhibition at Adelaide. 1900: Universal Exhibition at Paris.

BY the death of Mr. H. J. Slack, at the advanced age of seventy-eight, science has lost one of its most keen journalistic champions. In years when headway had to be made against prejudice and even antagonism, his enthusiasm inspired many younger workers, and he saw in the spread of science one of the great factors of social progress. For many years he edited the *Intellectual Observer*, which passed later into the *Student*, a journal which to him was largely a labour of love, and which, by its attractive form, had a wide educational value. His own researches were mostly in microscopy, and he was successively Secretary and President of the Royal Microscopical Society. Forty-six papers are ascribed to his name in the Royal Society's Scientific Catalogue; and his work entitled "The Marvels of Pond Life," passed through three editions between 1861 and 1878. In 1879, as President of the National Sunday League, Mr. Slack organised popular lectures for Sunday evenings in London, and did much to inaugurate that movement in furtherance of a rational Sunday, which has now gone so far as to receive parliamentary recognition. He was one of those who combined devotion to science with a broad sense of public needs; for him, science had its duties as well as its rights; and few can have come in contact with him without being the better for his cheerful and unflagging zeal in the causes which he had at heart. He was born on October 23, 1818, and died in his house at Forest Row, Sussex, on June 16, 1896.

A BILL to legalise the use of weights and measures of the metric system in this country was read for the first time in the House of Commons on July 30. The Bill is as follows:—"I. (1) Notwithstanding anything in the Weights and Measures Act, 1878, the use of a weight or measure of the metric system in trade shall be lawful, and nothing in section nineteen of that Act shall make void any contract, bargain, sale, or dealing by reason only of its being made or had according to weights or measures of the metric system. (2) A person using or having in his possession a weight or measure of the metric system shall not by reason thereof be liable to any fine. (3) For the Third Schedule to the Weights and Measures Act, 1878, shall be substituted the Schedule to this Act. II. Section thirty-eight of the Weights and Measures Act, 1878, is hereby repealed, and the Board of Trade shall verify copies of metric standards in the same manner as if they were copies of Board of Trade standards, and the provisions of that Act relating to the verification of local standards shall apply accordingly. III. In section forty of the Weights and Measures Act, 1878, the expression 'local standards of weights and measures' shall include local metric standards and the provisions of that Act relating to local standards shall apply accordingly." The Schedule to the Bill gives a series of equivalents of metric and imperial weights and measures. The Bill will not be proceeded with this Session.

A RETURN has been presented to Parliament showing the number of licensed experiments performed on living animals during the year 1895. The total number of persons holding licences was 213, but of these 65 performed no experiments. Tables are given which afford evidence (1) that the licences and certificates have been granted and allowed only upon the recommendations of persons of high scientific standing; (2) that the licensees are persons who, by their training and education, are fitted to undertake experimental work and to profit by it; and (3) that all experimental work has been conducted in suitable places. The total number of experiments performed in 1895 was 4679. In 1560 of the experiments performed the animal suffered no pain, because complete anæsthesia was maintained from before the commencement of the experiment until the animal was killed; 2358 of the experiments were practically always of the nature of hypodermic injections or inoculations. In 761 experiments the animal was anæsthetised during the operation, but was allowed to recover. These operations, in order to insure success, are necessarily done with as much care as are similar operations upon the human subject, and, the wounds being dressed antiseptically, no pain results during the healing process. The large number of inoculation experiments is, to a great extent, attributable to investigations connected with the production of diphtheria-antitoxins and analogous bodies. More than half of the experiments under Certificate B have been inoculations made (under anæsthetics upon rodents) with the object of diagnosing rabies, the public having largely acted upon the advice printed upon the back of dog licences, which is to the following effect: "If a dog suspected of being rabid is killed after it has bitten any person or animal, a veterinary surgeon should be requested to forward the spinal cord to the Brown Institution, Wandsworth-road (or some other licensed institution) in order that it may be ascertained with certainty whether the animal was suffering from rabies."

PROF. JOHN MILNE, writing from his observing station in the Isle of Wight in reference to the long series of earth disturbances commencing on June 29 in Cyprus (see NATURE, August 6, p. 325), says that he also has recorded a long series of movements commencing on that date. Two alarming and severe shocks in Cyprus, in G.M.T., commenced on June 29 at *about* 8h. 48m. 0s., and July 2 at *about* 18h. 13m. 0s. The Isle of Wight records commence on the above dates at 9h. 02m. 26s. and 18h. 51m. 29s.

PROF. DR. A. GERLAND, in the *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, gives an account of the earthquake in South-western Germany on January 22, 1896. The disturbance was in many ways remarkable, extending as it did over an area of about 40,000 square kilometres; and it seems to have had its origin at a considerable depth below the surface, as the recorded times of its occurrence are nearly identical over the whole region affected. The disturbance lasted on an average about five seconds, and was apparently of the nature of a sudden shock in an east to west or west to east direction, although in Strassburg and Stuttgart it seems to have been vertical; affording an excellent illustration of the fact, pointed out by Prof. Schmidt, that the direction of displacement is not necessarily connected with the direction of propagation of the disturbance. A remarkable feature of the disturbed region is the occurrence of isolated areas which remained unaffected; this is especially the case in the Jura, Le Locle and La Chaux le Fonds being the only stations reporting even a slight shock.

THE *Bollettino della Società Geografica Italiana* contains a note on some observations recently made by Dr. S. Angelini on the colour and transparency of the waters of the lagoon at Venice and of the Gulf of Gaeta. The depths at which white, green, red and blue discs, each 50 cm. in diameter, ceased to be visible from the surface, were measured with the following results:—

		White.	Green.	Red.	Blue.
Lagoon	Metres	1·98	1·85	1·80	1·50
Gulf of Gaeta	,,	8·50	7·80	7·00	6·00

The ratios of these numbers indicate a somewhat greater relative transparency in the waters of the lagoon for red and blue rays than for white or red.

DR. A. LINDENKOHL contributes to *Science* an abstract of a report on the work of American surveying vessels in the Gulf of Mexico and the region of the Gulf Stream during the last twenty years. The full memoir is to be published in the annual "Report of the U.S. Coast and Geodetic Survey" for 1895, and, amongst other important matter, includes a discussion of the sources from which the Gulf Stream derives its waters. It appears that the Gulf of Mexico supplies only a very small part of the whole, the currents entering and leaving it being inconsiderable both in volume and velocity.

HERR FRIEDRICH BENESCH contributes to the *Mittheilungen der K.K. Geographischen Gesellschaft in Wien* a short description of Pauliny's new method of drawing relief maps, which he says is a great advance on any method now in use, both in respect of accuracy and of ease in execution. The map is in effect a closely-contoured map, printed on silver-grey paper, the contour lines being white where illuminated by a source of light supposed to be 45° above the western horizon, and black elsewhere. Level plateaus and slightly sloping areas are thus represented by the natural grey colour of the paper; steep declivities towards the west are lightened by the closely drawn white lines, and towards the east correspondingly darkened by the black lines, the departure from the normal grey being greater the closer the lines, *i.e.* the steeper the slope. The method has the merit of giving a clear idea of *steepness* derived from the contour lines themselves; and while it does not demand the high standard of skill necessary in Lehmann's method of hachuring, the confusion produced by the shadows in some modern maps, where the illumination is supposed to come from the horizon, is avoided. Maps illustrating Herr Pauliny's method are to be published in Vienna in the course of the summer.

IN the *Atti dei Lincei*, Dr. Vittorio Abelli describes a remarkable case which occurred in the course of a scientific expedition on the slopes of Monte Rosa. At an altitude of 4560 metres, a member of the party, twenty-two years of age, was suddenly attacked with pulmonitis, and subsequently completely recovered from the disease. This led Dr. Desiderio Kuthy, of Budapest, to carry on a series of experiments on the action of rarefied air on the *Diplococcus* of pulmonitis, and also on the *Pneumococcus* of Fraenkel. Two conclusions were drawn from these investigations: firstly, that rabbits after being inoculated with this *Pneumococcus* die more rapidly when they are surrounded by air at the reduced pressure corresponding to that on Monte Rosa; secondly, that this occurs although the *Pneumococcus* is less virulent when it is developed in rarefied air. In the case of the youth Ramella, Dr. Kuthy considers that the infection was mitigated in consequence of the attenuation of the *Pneumococcus* arising from the rarefaction of the air, but the same circumstance caused the attack to be more violent in spite of the mildness of the infection.

IN the *Nuovo Cimento* for June, Dr. A. Fontana describes a new form of slide-rule designed for the purpose of shortening the calculation of the corrections which have to be applied when a body is weighed in air, and its weight *in vacuo* is required. The device bids fair to prove very useful in physical laboratories where weighings are constantly being made.

AT the conclusion of a lecture on the transformation of the energy of carbon into other available forms, recently delivered before the Franklin Institute by Mr. C. J. Reed, the Jacques cell, described in a note in these columns on July 30 (p. 298), was referred to. Several experiments were performed to show that the cell is a thermo-electric one. "It was shown (we quote the Society's *Journal*) that, at low temperatures, while the caustic alkali contained considerable water, the carbon was positive to the iron; but that at a high temperature, after the alkali had become highly dehydrated, the carbon was negative to the iron. The carbon rod was replaced, successively, by rods of brass, copper, German-silver, and iron, without appreciably affecting the result, and a current of illuminating gas was passed into the fused alkali in place of the current of air employed by Jacques. The result was unchanged, showing that the action of the current of air was not to produce oxidation, but to cool the upper layer of the alkali."

IF the stability of a nation is measured by the amount of care bestowed upon forests, the power of Germany is not likely to decline. Mr. G. A. Daubeny contributes to *Nature Notes* a chatty account of forestry in Germany, where more than twenty-five per cent. of the land is covered with trees. In Prussia, twenty-three per cent. is forest; but in England the proportion of forest land is small—only four per cent. There is quite an army of foresters in Germany—about twelve thousand in all—and, as is well known, these officials receive a thorough training in all the branches of their subject. Mr. Daubeny ascribes the decayed power of Syria, of Greece, and of Spain to the neglect of their forests, and urges the afforestation of land as a means of developing national resources. "Den Wald zu pflegen, bringt allen Segen," says a German proverb; and even if the care of forests does not bring every good, it adds considerably to the wealth of a nation.

UNDER the title "Publications of the Smithsonian Institution," by Mr. W. J. Rhees, a list of a number of papers printed from the Institution's Contributions to Knowledge, Miscellaneous Collections, and Annual Reports, for sale or exchange, has been issued. The papers are classified according to a comprehensive scheme of subjects, and are fully indexed. Every student of science will find in the list works which he will be anxious to possess.

WE have received from Messrs. Marcus Ward and Co. a small portfolio of forty coloured prints of common native and introduced plants found in Manitoba. There is no explanatory letter-press, and nothing to show whether there are more to come or not. All we can say for them is that the figures are tolerably well drawn, though often crudely coloured. Still they are recognisable, and may prove serviceable to persons who wish to know the names of plants growing in their neighbourhood.

LOCAL scientific societies keep alive the spirit of inquiry, but they often err on the side of dilettantism. We are afraid the *Proceedings* of the Bath Natural History and Antiquarian Field Club comes into this category, for though the number (vol. viii. No. 3) just received contains a helpful paper by Mr. A. Smith Woodward on the collection of fossil fishes from the Upper Lias of Ilminster, in the Bath Museum, and some notes of local antiquarian interest, there is also a description of an excursion to witness a diviner's experiments in water-finding. It would be well if societies like that at Bath would help more seriously to extend natural knowledge than many of them do at present.

TWO ponderous volumes of the "Palæontologia Indica"—a publication which, as every geologist knows, is devoted to the description and illustration of organic remains procured during the progress of the geological survey of India—have lately reached us. In one of them (Series xiii. vol. ii. part i.), Dr. William Waagen continues his work on "Salt-Range Fossils" by descriptions of the fossil contents of the Ceratite beds. These beds are believed to represent the Trias of Europe, but it is not possible to say exactly what parts of the Trias are represented by them, though Dr. Waagen's contribution will enable the question to be profitably discussed. The fossils which are obtained from the Ceratite formation of the Salt-Range are chiefly Cephalopoda, only a few remains of fishes having been found. The present volume contains the determinations of the genera of the few specimens available, but by far the greater part of it is devoted to the Ammonoids. The specific descriptions of the fossils, and the remarkably fine plates which illustrate them, will prove of prime importance in the further consideration of the classification of that order. In the definition of the genera and families treated by Dr. Waagen, the groups are minutely characterised, but the developmental connection is only kept in sight so far as it has been demonstrated. It is held that, in the present state of our knowledge, it is undesirable to do more than arrange the single genera according to their affinities in smaller groups, or families. Dr. Waagen's memoir will, however, enable the developmental relations to be more fully worked out than has previously been possible.

THE second memoir referred to in the foregoing note belongs to Series xv. of the "Palæontologia Indica." In it Dr. Carl Diener describes "The Cephalopoda of the Muschelkalk." The volume is a monograph on the Cephalopoda of the Muschelkalk—a distinct geological horizon in the Himalayan Trias, regarded by Dr. E. von Mojsisovics as a connecting-link between the triassic Mediterranean and Arctic-Pacific provinces. Dr. Diener has used a wealth of palæontological materials in preparing his work, and his interpretation of them is a valuable contribution to the knowledge of the triassic fauna of the Himalayas. In a third publication to which we must call attention (*Memoirs* of the Geological Survey of India, vol. xxvii. part 1), Dr. F. Noetling describes "Some Marine Fossils from the Miocene of Upper Burma." Sixty-nine species are described, and fifty-one have been determined. From these identifications it is seen that the fauna represents a marked Indian facies, slightly sprinkled with a more Southern element from Java.

AT the beginning of last year it was decided by the United States Congress that future annual reports of the Department of Agriculture should be divided into two volumes: first, an executive and business report; and second, a volume "specially suited to interest and instruct the farmers of the country," made up of papers from the Department bureaus and divisions. This latter volume ("Yearbook of the Department of Agriculture, 1895") has recently been distributed, and it will undoubtedly extend agricultural knowledge in the United States. In the first place, the volume contains a general report of the operations of the Department during 1895. Then there is a series of thirty-three essays by experts, discussing in easy language the results of investigations in agricultural science and new developments in farm practice. As years go on, successive issues of Yearbooks of this kind will give farmers a good library covering the applications of science to practical agriculture. In an appendix, a large amount of miscellaneous information, taken from the reports of the Department, is presented with especial regard to the agricultural reader. It is impossible for us even to enumerate the many papers contained in the volume. Valuable data, facts of interest, recipes, directions with regard to agricultural practice, and descriptions of the relation of forests to farms, insect pests, principles of pruning, soil ferments, common birds of the farm and garden, and co-operative

road construction are given in an instructive and interesting form. To quote the words of Mr. C. W. Dabney, Assistant Secretary of the Department: "It has been sought to make the volume a concise reference book of useful agricultural information based in great part upon the work of this and other Departments of the Government, without making it an encyclopædia of general information. In brief, the effort has been to make a book, and not a mere Government report—a book worthy to be published in an edition of half a million copies and at an expense to the people, if we count both publication and distribution, of over four hundred thousand dollars." The money thus spent in disseminating accurate knowledge of agricultural investigations may appear excessive, but it will be returned to the country a hundred-fold.

THE additions to the Zoological Society's Gardens during the past week include a Black-faced Kangaroo (*Macropus melanopus*, ♂) from Australia, presented by Mr. G. T. Wills; a Loder's Gazelle (*Gazella loderi*, ♀) from Oued Souf, Algeria, presented by Mr. A. B. Birdwood; a Gazelle (*Gazella* ——), two Hairy-footed Jerboas (*Dipus hirtipes*), a Spot-bellied Snake (*Zamenis ventrimaculatus*), an Ocellated Sand Skink (*Seps ocellatus*) from Arabia, presented by Dixon Bey; a Common Cormorant (*Phalacrocorax carbo*), British, presented by Miss G. Howell; two Passerine Parrots (*Psittacula passerina*) from South America, presented by Miss L. Scott Moncrieff; a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Grey Ichneumon (*Herpestes griseus*) from India, deposited; two Patagonian Cavies (*Dolichotis patachonica*), two Ypecaha Rails (*Aramides ypecaha*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

BROOKS'S COMET.—This comet, which M. Javelle, of Nice, has fortunately re-discovered, remains so faint an object, that other observations for the improvement of the elements, computed by Dr. Bauschinger, are still wanting. The one position secured has been utilised to correct the mean motion, and consequently the time of perihelion passage. This will take place November 4·18375, Berlin mean time, or only 0·2083 days later than the time determined from the last appearance. The excentricity needs probably a small correction, but the data for its determination are not yet existing. The following ephemeris, for Berlin midnight, is derived from the corrected mean motion and time of perihelion passage.

1896.		R.A. h. m. s.	Decl. ° ′ ″	Brightness.
Aug.	13	22 32 43·50	−18 54 24·1	1·8
	16	30 58·66	18 59 1·0	1·9
	20	28 26·73	19 4 4·9	1·9
	24	25 44·87	19 7 30·7	2·0
	28	22 58·22	19 8 52·5	2·0
Sept.	1	20 11·78	19 7 49·1	2·1
	5	17 31·14	19 4 1·2	2·1
	9	15 2·04	18 57 10·7	2·1
	13	12 49·63	18 47 8·8	2·0
	17	10 58·23	18 33 53·0	2·0
	21	9 31·79	18 17 22·7	2·0
	25	8 32·66	17 57 45·6	2·0
	29	8 2·93	17 35 8·0	1·9

For finding the comet, the bright star Fomalhaut will still be convenient, the region comprised in the ephemeris being about 11° north of the star, and on the meridian (London) about 1·45 a.m.

METEOR TRAILS.—We noted on July 30 (p. 301) that attention has been called by Prof. Johnstone Stoney and others to the desirability of observing the meteors in November next, which are likely to form part of the great November shower, particularly with the view of settling the question of the date at which the shower was introduced into the solar system. Improved methods of observation might have been expected to furnish more accurate information, and lead to a closer approximation to the orbit. It is therefore disappointing to read in the Report issued by Dr. Elkin, the Director of the Yale Observatory, that, notwithstanding repeated efforts, no photographic records of meteor trails have been secured. The apparatus was in use for the August meteors, but none were of sufficient brilliancy to impress themselves upon the film, which had become somewhat fagged by the strong moonlight. Other occasions were equally disappointing; but the Director is not discouraged, and in place of the two lenses now employed he hopes to substitute the complete battery of lenses for which the mounting was originally planned.

PERSONAL EQUATION IN OBSERVING TRANSITS.—The vexed question of the existence and necessary removal of personal equation in determining clock error has been attacked by Mr. R. H. Tucker, of the Lick Observatory. The particular form of the question to which Mr. Tucker has applied himself is that raised some years since by Prof. van der Bakhuyzen, of the effect of the brilliancy of the star on the time of transit determined by chronographic registration. Mr. Tucker placed over the object-glass four thicknesses of wire netting, which reduced the magnitude of the star 4·1 magnitudes, or, in other words, destroyed all but one forty-fifth part of the original light. The clock error was determined from the observations of stars, with and without the screen alternately, with the result that the faint stars were observed 0·037s. later than when seen at their full brilliancy. The correction to observed right ascension is −0·009s. for each magnitude, with a probable error of ±0·001s.

RECENT RESEARCHES ON RÖNTGEN RAYS.

THE subjoined summary brings together in a convenient form for reference a number of researches on Röntgen rays which have recently come under our notice. It will be seen that a large amount of detailed information with reference to the character and capabilities of the rays is being accumulated by investigators in various parts of the world.

Dr. A. Dupré, F.R.S., writes, under date July 29:

"The article by Mr. Benjamin Davies, in your issue of July 23, has recalled to my mind certain experiments of my own, made several months since, which may perhaps throw some light on Mr. Davies' results. I was then working with various vacuum tubes, and among others with an ordinary Geissler tube containing nitrogen, such as is used for obtaining spectra of gases. The capillary part of this tube gave a brilliant light, which had the power of inducing fluorescence of many substances, to a remarkable degree, the light falling direct on to the substance. The tube being in action, the screen covered with platino-cyanide of potassium fluoresced strongly ten feet from the tube, the active surface being towards the tube. This was, of course, to be expected, but, to my astonishment, the fluorescence was almost equally noticeable when the back of the screen was turned towards the tube, and remained so even when I interposed a book, a board, a sheet of tin-plate, or the human body between the tube and the screen. When, however, I placed my hand against the back of the screen, no trace of a shadow was noticeable; the same was the case when pieces of metal, or other objects opaque to the Röntgen rays were so placed. The screen all the while remaining strongly and uniformly fluorescent. This seemed to me to show that, whatever the nature of the rays producing the fluorescence of the screen, they could not be Röntgen rays; and I concluded that the fluorescence was really due to light striking the front, or active, surface of the screen after reflection, either from the walls of the room, or, perhaps, from the air. When accordingly all possibility of any light thus reaching the screen was excluded, all fluorescence was effectually stopped. Might it not be possible that in Mr. Davies' experiment the fluorescence of his screen was in part, at least, induced by rays reaching the active surface of the screen after reflection? Thus accounting for the fact that the hand cast no shadow whatever."

Mr. J. A. M'Clelland read a paper on the "Selective Absorption of Röntgen Rays" before the Royal Society on June 18. The experiments described in the paper were made to determine whether or not the Röntgen rays given off by a vacuum bulb were of a homogeneous nature, by examining the manner in which they are absorbed by different substances. The substance whose absorptive power was to be examined—say, a plate of glass—was placed so that the rays traversed it before falling on a charged disc, which was in connection with a pair of

quadrants of an electrometer. The disc was discharged by the rays, and the transparency of the substance was measured by the rate at which the spot of light from the electrometer needle moved across the scale. Sheets of tinfoil were then substituted for the glass, and the number—*n*, say—taken, such that the rate of discharge of the disc was approximately the same as with the glass. The rate of discharge was accurately measured in the two cases. The ratio of the rate of discharge with the glass to that with the *n* sheets of tinfoil gave a measure of their relative transparency to Röntgen rays. The rays were then made to pass through a number of sheets of tinfoil, and then through the glass, and the rate of discharge measured. The glass was removed, and the same *n* sheets of tinfoil as were formerly used put in its place, and the discharge again measured. The ratio of the rate of discharge in the latter two cases was a measure of the relative transparency of the glass and the tinfoil sheets to Röntgen rays which had been already screened by passing through tinfoil. If the Röntgen rays were all of one kind, the two ratios thus obtained should be equal, but a difference in the ratios could only be explained by assuming that the rays were not homogeneous, and that some were more readily absorbed by the tinfoil, and others by the glass or other substance used. Various substances were tested against tinfoil in this manner. With some there was no selective absorption, with others it was very marked. Glass gave none, with mica and paraffin the effect was small, with fuchsine, eosine, and a number of other substances the effect was very marked. A table, given in the paper, showed the results obtained with these and other substances. The author concluded that the Röntgen rays are of different kinds, and that the substances given in the table differ very much from tinfoil in their selective absorption. It is important to observe that these results were obtained with a vacuum bulb which was working extremely well and discharging the disc very rapidly. With another bulb, which was not nearly so efficient, no evidence of selective absorption could be obtained. The radiation from this bulb was homogeneous as far as could be determined by this experiment. With a third bulb, better than the last, but not so good as the first, selective absorption was obtained, although less marked than with the first bulb. It seems, therefore, that as a tube becomes more efficient the character of its radiation becomes less homogeneous.

The effect of Röntgen rays in discharging electrified bodies continues to form the subject of investigation of several Italian physicists, whose conclusions may with interest be compared with the results obtained by Prof. J. J. Thomson in this country. Prof. Emilio Villari (*Atti della R. Accademia dei Lincei*) enunciates the following conclusions, in support of which an elaborate series of experiments are fully described. (1) The discharge of a conductor in air, when provoked by Röntgen rays, takes place by an electrical convection of the particles of air set in action by the radiations. (2) The discharge is retarded if the surface of the electrified conductor exposed to the air is diminished by covering part of it with paraffin. (3) When the conductor is covered all over with paraffin placed in contact with it, the discharge stops almost immediately after it has been started by the Röntgen rays. A little electricity conveyed by the surrounding film of air charges the paraffin, and further discharge was prevented. (4) If the conductor is surrounded by air enclosed within a tube of paraffin, and subjected to Röntgen rays, the discharge at first takes place fairly rapidly, but subsequently proceeds extremely slowly. The electricity carried off as usual by the air suddenly charges the walls of the tube, and afterwards is dispersed with difficulty. (5) The electricity dispersed by the body can be collected on a tube of paraffin, as in the preceding case, or on an insulated metal tube surrounding the discharged body. This collected electricity can be observed with an electroscope, and it is, of course, of the same kind as that of the body. (6) Metal tubes, whether insulated or not, surrounding the electroscope, serve to condense on it the charges imparted to them. They retard the discharge produced by Röntgen rays, either on account of the quantity of electricity accumulated by them, or owing to their imperfect transparency to the rays.

Prof. Augusto Righi (*Atti della R. Accad. dei Lincei*) also *still* considers it "non proven" that any but a gaseous dielectric becomes a conductor under the influence of Röntgen rays, thus agreeing substantially with Prof. Villari. Prof. Righi, however, has discovered a source of error in his previous experiments, which, however, does not affect this result. If in front of the aluminium window of a leaden box containing the Crookes' tube, a large disc of lead is placed, and the charged body is situated in the geometrical shadow cast by the disc, it might be supposed that no discharge would take place; but such is far from being the case, except when the leaden disc is closely pressed against the window.

In the succeeding number of the *Atti dei Lincei* this deflection of Röntgen rays behind opaque bodies is discussed at considerable length by Prof. E. Villari, who claims to have recorded the phenomenon as long ago as March last. Observations were made on the discharge of an electroscope placed in different portions of the shadow cast by a plate of lead, and, moreover, photographic impressions were obtained upon a sensitive plate placed just inside the geometrical umbra. Signor Villari concludes, that in order to discharge an electroscope it is not necessary that Röntgen rays should fall directly upon it. The presence of air previously traversed by these rays is sufficient to promote the discharge—a result in accordance with one o Prof. Röntgen's original observations.

In a subsequent paper in the same publication, Prof. Righ proves that the discharge of electricity produced in air by Röntgen rays takes place by convection *along the lines of electrostatic force*. The experiments were made by means of an insulated conducting sphere placed in the presence of a disc of ebonite having its lower side covered by a metal armature. Between the two a cross of ebonite was placed, and the conductor and armature were oppositely charged. After exposing the whole to the action of Röntgen rays for a few minutes, the ebonite was dusted over with a mixture of powdered red-lead and sulphur, when the shadow of the cross appeared red on a yellow background. In another experiment a cylindrical conductor was substituted, and the shadow was produced by a strip of ebonite placed parallel with its axis. The observed position of the shadow agreed exactly with that calculated from the form of the lines of electrostatic force, which in this case were, of course, coaxial circles.

It should be observed, however, that if the phenomenon were one of *conduction* instead of convection, the discharge would still follow the lines of force, just as in Prof. Righi's experiments.

The same indefatigable observer (Prof. Righi) also discusses in the *Comptes rendus* a paper by MM. Benoist and Hurmuzescu, who find that, "if Röntgen rays can develop an electric charge . . . this effect does not exceed the order of magnitude of the electromotive forces of contact." Prof. Righi finds that the positive potential to which an insulated conductor is raised when Röntgen rays fall on it, *is precisely* of that order of magnitude. In the experiments of MM. Benoist and Hurmuzescu, the electrometer and the conductor experimented on were enclosed in an uninsulated metal case; in Prof. Righi's experiments the case was made to enclose the Crookes' tube, which was placed at a considerable distance from the conductor, so as to remove the latter as much as possible from the influence of all conducting bodies. It appears probable that both dispositions are equally good.

Under the title "Raggi Catodici e Raggi-X" (*Nuovo Cimento*), Prof. Battelli and Dr. Garbasso give a continuation of their researches bearing chiefly on the question of whether there is really an essential difference between Röntgen rays and kathodic rays. These writers are of opinion that the two kinds of radiations do not differ from one another in any more essential characteristics than those which enable us, for example, to distinguish two flames of different colour.

In a further contribution to the *Nuovo Cimento*, Prof. Battelli and Dr. Garbasso examine the resemblance between Röntgen rays and ultra-violet light in their power of dispersing electric charges. The experiments, which were made by employing alternately a Crookes' tube and a voltaic arc with the same disposition of apparatus, lead to the conclusion that although ultra-violet light acts on electrified bodies in the same manner as Röntgen rays, the modification produced in the surrounding air (in the case of ultra-violet light) is less pronounced and less stable.

An important point in connection with the debated nature of Röntgen rays is the determination of their wave-length, which has been successfully effected by Dr. L. Fomm, of Munich (*Sitzb. der Bayerischen Akademie*, xxvi. ii.). As these rays show no measurable reflection or refraction, the only way available was by diffraction. The Röntgen rays emanating from a large Hittorf tube were made to pass through a brass slit 0·5 mm. in breadth, and, after being diffracted by a second slit, were received on the photographic plate. The

width of the second slit could be varied from 0·1 mm. up to 2 mm., and with the former width an exposure of fifty minutes was required. As long ago as March last, Dr. Fomm obtained photographs showing interference bands, thus affording proof of the undulatory nature of Röntgen rays. By starting with a very narrow slit and gradually increasing its width, the interference lines approach closer together, until a dark line—the first minimum—appears in the centre. As the opening becomes still wider, this minimum gives place to a maximum with two minima, one at each side, and so on, and by means of Lommel's formula, the wave-length can be determined from this phenomenon. Dr. Fomm obtains $\lambda = 0{\cdot}000014$ mm., so that the wave-length is about fifteen times smaller than the smallest wave-length hitherto observed in the ultra-violet. Owing to the difficulty of determination, Dr. Fomm regards this number as giving the upper limit rather than the exact measure of the wave-length of the observed rays. Meanwhile MM. G. Sagnac, L. Calmette, and G. T. Lhuillier have published investigations in the same direction (*Comptes rendus*, cxxii. 13 and 16). M. Sagnac uses a wire grating, and from a scarcely measurable diffusion of the image of the slit he obtains 0·00004 as an upper limit to the wave-length. MM. Calmette and Lhuillier have made diffraction experiments with two slits, and have obtained bright and dark lines without expressing an opinion as to the wave-length of the rays.

Another closely allied question is whether Röntgen rays consist, like ordinary light, of radiations whose wave-lengths vary over a considerable range. Such differences of wave-length give rise in the case of light to the phenomenon of colour, and the corresponding phenomenon for Röntgen rays has been studied by Dr. F.-V. Dwelshauvers-Dery (*Bulletin de l'Académie Royale de Belgique*, No 6) under the name of *actinochroism*. Observing that differences in the degree of exhaustion of a Crookes' tube might be expected to give rise to differences of wave-length in the emitted rays, and that the higher the vacuum the shorter would the wave-lengths probably be, Dr. Dwelshauvers-Dery has examined whether certain substances are more transparent for certain Röntgen rays than for others. For this purpose, their transparencies were compared by placing the substances in front of a fluorescent screen and observing their shadows side by side with that of a test-object consisting of laminæ of tin-foil, whose total thickness could be varied at pleasure. To obtain the necessary variation in the nature of the Röntgen rays, it was found sufficient to compare the radiations from a new tube, which had not been previously used, with those emanating after the tube had been in action for some time. The observations were repeated on the new tube after a quarter of an hour, half an hour, an hour, an hour and a half, and two hours respectively, and transparency-curves obtained by plotting the results on paper. These curves show that (1) the transparency of every specimen, with the exception of obsidian, increases during the first few minutes; (2) agate and alum, after increasing in transparency for some time, become more and more opaque; (3) obsidian continually diminishes in transparency. It is, of course, here a question of relative transparency with respect to tin. Although we have no measure of the variations of the absolute transparency of the tin itself, the experiments suffice to prove that the absolute transparencies of different substances vary according to the state of the tube, and it is therefore, not considered hazardous to explain these variations by the actinochroism of Röntgen rays.

The same phenomenon has been observed by MM. Benoist and Hurmuzescu and, perhaps, by other physicists. In some of Mr. A. A. C. Swinton's experiments it will be remembered that the properties of Röntgen rays, and particularly their power of penetrating through organic tissues, varied with the degree of exhaustion of the vacuum.

Two papers on Röntgen rays appear in a recent *Bulletin de l'Académie Royale de Belgique* (No. 5). One, on the probable cause of the production of Röntgen rays and of atmospheric electricity, and on the nature of electricity, is by P. de Heen. Judging from the analogy of a pith ball oscillating between two electrified plates, and from the comparative sizes of the pith ball and the air molecule, it may be assumed that the molecules have a velocity of 330,000 metres per second. This agrees fairly well with J. J. Thomson's estimate of a velocity of 200,000 m. per second for the kathodic projections. Such a velocity corresponds to the excessively high temperature of 46 million degrees. Hence, wherever these molecules impinge upon a surface, they will produce ether waves of very high frequency. These waves are probably identical with Rontgen rays, which are therefore very short ultra-violet waves. The author also claims to have proved that an electrified surface impresses a sensitive plate quite apart from any radiating action. He proposes the theory that positive and negative electricity are propagated in different ways, the former by transverse, the latter by longitudinal, waves. Atmospheric electricity is generated by masses of gas emerging from the interior of the sun (protuberances), which send out ultra-violet waves, and charge the atmosphere positively and the earth negatively by induction.

The reflection of Röntgen rays is treated by F. V. Dwelshauvers-Dery, in the *Bulletin* referred to in the foregoing paragraph. No trace of a regular or geometric reflection of Röntgen rays can be discovered. The wave-length of the rays is evidently too small in comparison with the size of the molecules. In order to find whether there was any diffuse reflection, the author placed a sensitive plate with the film downwards. A piece of ruby paper half covered the film, and sheets of zinc, brass, copper, tin, and collodion were placed under this. Then followed a second plate with the film upwards. On exposing the whole to Röntgen rays, both transmission and reflection could be studied. As regards the former, it was found that collodion increased the activity of the rays. This fact may be utilised to diminish the exposure, a sheet of collodion being placed above the object and the film. Impressions were also obtained on the upper plate, apparently due to diffused reflection. The order of reflective power was: tin, zinc, copper, brass, iron, platinum, gold, lead, aluminium. Hence tin placed below the film may also be used to diminish exposure. The state of polish of the surface was without influence, which shows that there was no regular reflection. But the most important fact is that the ruby paper intercepted a large proportion of the reflected rays. Hence the latter are not Röntgen rays proper, but rays of greater wave-length, and it may be maintained that X-rays are not reflected as such.

Herr W. Arnold (*Centralblatt für Nahrungs- und Genussmittel-Chemie sowie Hygiene*) shows that Röntgen rays can be employed with considerable success in the detection of food adulteration. Carbohydrates, fats, and aniline dyes were found to be very transparent to these rays, though slight differences were noticeable. Among the vegetable oils the order of transparency was: (1) castor oil, (2) almond oil, (3) olive oil of Provence, (4) poppy oil, (5) oil of sesame, (6) linseed oil; the difference between the last five was very slight, but castor oil was considerably more transparent. Of fats, butter was the least transparent, lard came next, and margarine was the most transparent; while the opacity of a mixture of different fats was found to vary with the percentages of its constituents. Among the spices, Herr Arnold found that the transparency decreased as the proportion of ash increased, so that saffron was the least and pepper the most absorbent of Röntgen rays. Foreign matter mixed with spices, such as brick-dust, ochre, sand, &c., was conspicuous, while adulterations of flour with powdered fluor or other spar, or chalk, could readily be detected. Earthenware glazes containing lead differed strongly from ordinary glazes, since, of all substances, lead offers the greatest resistance to the passage of Röntgen rays. For colouring matters imbedded in gelatine the order was: (1) methylene blue, (2) cyanin, (3) methyl violet, (4) eosin, (5) fuchsin, (6) brown, (7) orange, (8) chrysanilin, (9) fluoresin; the order must thus be blue, red, yellow, so that the lightest colours are the least transparent. In wines the transparency decreased as the proportion of sugar increased, just as generally the absorbing power of fluids increased with their specific gravity, and that of the elements with their atomic weight. In salts, the radical had considerable influence, and arseniates, sulphates, and phosphates exhibited a far greater power of absorbing the rays than chlorides.

The same writer also discusses the luminosity of solids under the influence of Röntgen rays. Referring to the use of fluor spar in shortening the time of exposure of radiographs, as employed by Winkelmann and others, Herr Arnold states in the *Apotheker-Zeitung* that he and Herr Forster-Bern have obtained negative results, as no difference was noticed between the action of the rays on plates exposed with and without the spar; possibly this was due to the quality of the spar employed. In the *Zeitschrift für Electro-chemie* he states the results of a long series of observations on various forms of luminosity, namely, thermo-luminosity, kathodo-luminosity, and what he proposes to call "X-luminosity." Herr Arnold finds tungstate of lime to

be the most luminous of all salts under the action of Röntgen rays, especially when in the form of the mineral known as tungsten. He thinks it exhibits the phenomena even in a more marked degree than platino-cyanide of barium. A solution of tungstate of copper in tungstate of calcium, moreover, glows with the same brightness as natural tungsten. A note on the best form of tungstate of calcium for showing fluorescence has also been published by Dr. Ferdinando Giazzi, of Perugia. By a certain process of heating in a coke furnace in the presence of oxygen, the tungstate is reduced to a white saccharoid mass which gives a much more brilliant glow than ordinary tungstate, but the effect can be further intensified by pulverising the mass and repeating the process, the final product which Dr. Giazzi calls the "bisaccharoid" form being, in his opinion, the best substance for shortening the exposure and intensifying the brilliancy of photographs taken with Röntgen rays.

Prof. Giuseppe Martinotti (*Rivista Scientifico-Industriale*) claims to have obtained shadow photographs of metal objects by the use of different kinds of light (including that of bisulphide of carbon), the light from a sulphur flame being found the best. Perhaps the radiations by which these results were obtained may be identical with Le Bon's *lumière noire*. This latter phenomenon deserves to be more fully investigated by physicists than has been done.

At a recent meeting of the *Société Française de Physique*, a discussion took place on a new arrangement of vacuum tube introduced by M. Colardeau, which gives, with short exposures, great clearness of images. The ordinary "focus" tubes are, according to M. Colardeau, open to several objections; amongst others, the thickness of the glass required to stand the external pressure arrests the passage of a large proportion of the rays; the energy of the discharge is not sufficiently concentrated round the kathode, and the distance between the kathode and anti-kathode is too great. The new form of tube is a cylinder of not more than 6 or 7 mm. diameter, containing a concave kathode of 4-5 mm. radius of curvature, which nearly fills the width of the tube. The lamina inclined at 45°, forming the anti-kathode, is only 7-8 mm. distant from the kathode, and just opposite the focus; and the glass of the tube is blown out into a hemispherical knob 1/10 mm. in thickness; the latter offers but little resistance to the passage of the rays generated at the focus. With this disposition stereoscopic radiographs were taken, which stand out in remarkable relief. The tube has stood the test of a discharge from a coil of very large dimensions without the least injury.

Finally, we would call attention to the excellent radiograph of an entire newly-born child taken by Prof. A. Imbert and M. H. Bertin-Sans, of the University of Montpellier, which is reproduced in the *Revue Générale des Sciences* for June 30. In sharpness of outline and general detail it far excels anything previously attempted in this direction.

METALLIC CARBIDES.

UNTIL about three years ago, the only definite compounds of carbon with metals whose existence had been proved with certainty were the acetylides of some of the metals of the alkalis and alkaline earths, and these were only known in an amorphous and impure state. The construction of the electric furnace by M. Moissan in 1893, in which the heating power of the electric arc was directly utilised, by extending the upper limit of working temperatures, added a powerful instrument of research to the laboratory. Among the many new fields of work thus opened up, the preparation of the difficultly reducible metals, such as tungsten, molybdenum, manganese and chromium, was attacked with much success by M. Moissan. These reductions being necessarily effected in the presence of carbon, the formation of definite metallic carbides of great stability soon became apparent, the properties of which proved to be of such interest that their preparation was systematically attempted. Certain metals, such as gold, bismuth, lead, and tin, do not form carbides at the temperature of the electric furnace, neither do they dissolve any carbon. The metals of the platinum group dissolve carbon with facility, but deposit the whole of it on cooling in the form of graphite, the metals being unchanged. Copper, silver and iron take up carbon in quantities that, although small, are sufficient to cause marked changes in the physical properties of the metals; it is noteworthy that no definite crystalline compound could be obtained with iron. On the other hand, fused aluminium takes up carbon readily with formation of the crystalline carbide Al_4C_3, and the oxides of many other metals furnish similar crystalline compounds when heated in the electric furnace with an excess of carbon. The behaviour of these substances with water furnishes the most convenient mode of classification. The carbides of molybdenum, Mo_2C, of tungsten, W_2C, of titanium, TiC, of zirconium, ZrC and ZrC_2, and of chromium, Cr_4C and Cr_3C_2, do not decompose water at the ordinary temperature. Of those reacting with water, the carbides of lithium, Li_2C_2, calcium, CaC_2, strontium, SrC_2, and barium, BaC_2, furnish pure acetylene; of aluminium, Al_4C_3, and of beryllium, Be_2C, pure methane; of manganese, Mn_3C, a mixture of equal volumes of hydrogen and methane; whilst the metals of the cerite group give crystalline carbides of the type RC_2 (CeC_2, LaC_2, YC_2, and ThC_2), all of which react with cold water, forming a complicated gas mixture containing hydrogen, acetylene, ethylene, and methane. But the most complex reaction is that furnished by uranium carbide, U_2C_3, with water. In this case, in addition to a gaseous mixture containing methane, ethylene, and hydrogen, liquid and solid hydrocarbons are produced in abundance, more than 100 grams of liquid hydrocarbons being obtained in one experiment from four kilograms of carbide. Cerium and lanthanum carbides have also furnished small quantities of solid and liquid hydrocarbons.

With the exception of chromium and zirconium, which form Cr_4C, and Cr_3C_2, ZrC_2, and ZrC respectively, only one carbide of each metal appears to exist, the formula of which is usually simple, and not always in accordance with what would be expected from the position of the metal in the periodic system. Thus, whilst the carbides of calcium, strontium, and barium have the formulæ CaC_2, SrC_2, and BaC_2, and yield pure acetylene upon treatment with water, beryllium forms Be_2C, from which pure methane is obtainable (Lebeau). As already mentioned, aluminium forms Al_4C_3 giving pure methane, whilst the higher members of the same group, yttrium and lanthanum, give YC_2 and LaC_2, yield, with water, complicated mixtures of acetylene, hydrogen, ethylene and methane, together with some liquid hydrocarbons. Cerium and zirconium, again, which are closely allied in the periodic system, form carbides having totally different properties, CeC_2 giving acetylene and methane with water, ZrC and ZrC_2 being unattacked under the same conditions.

These discoveries have already been applied technically in two directions—in the commercial production of acetylene from calcium carbide for enriching coal gas or for burning alone, and in the production of the carbides of silicon, CSi (discovered by Acheson), and of titanium CTi, both of which are extremely hard, the latter even cutting diamond. In organic chemistry, also, they afford a direct synthesis of many hydrocarbons, and offer a means of preparing pure methane and acetylene in large quantities. But perhaps their greatest interest lies in their bearing on certain geological problems. Starting with the fact that cast iron on solution in dilute acids gives a mixture of hydrocarbons, Bjasson and Mendelejeff twenty years ago suggested, independently, that the deposits of petroleum may be due to the infiltration of water into molten masses of metallic carbides, and this view was supported by an observation made about the same time by Silvestri, that some lavas of Etna contained petroleum.

In discussing this question in the light of his own observations, described before the Royal Society on June 18, M. Moissan protests against too hasty generalisation in this matter, as petroleums of different origins may exist, there being clear evidence in some cases that bituminous schists have been formed by the decomposition of organic matters. On the other hand, there is the continuous evolution of methane at Bulgonak and in Pennsylvania, which might well be formed by the action of water upon aluminium carbide; the presence of free hydrogen in the submerged volcanic vents at Santorin (Fouqué), and the occurrence of petroleum and carbonaceous products towards the end of a volcanic eruption, the violence of which would be fully accounted for by the supposition of the entry of water upon metallic carbides at a high temperature. There is also the possibility of explaining the occurrence of petroleums of different composition, for whereas a deposit of the carbides of the alkaline earths would yield acetylene, which at the extremely high temperature necessarily produced and in presence of free hydrogen might be expected to yield hydrocarbons of the Russian type, the carbides of aluminium and uranium, at perhaps a lower temperature, might account for petroleums of the American type. The whole work is extremely suggestive to vulcanologists, and will doubtless result in further investigation on the geological side.

G. N. H.

ITALIAN SCIENTIFIC EXPEDITION TO MONTE ROSA.

REFERRING to the letter published in NATURE (No. 1307, November 19, 1894), we have been able this year to complete our researches on the waters of the Monte Rosa from the highest summit down to the glacial streams and lakes at about 2000 metres above the sea level.[1] Having carried up to our laboratory on the Lavez Alp (2450 m.) a good analytical balance, some quantitative determinations could be made on the spot. As might be anticipated, the amount of suspended matter in the water of the streams issuing immediately from the glaciers varies considerably not only on different days, but even in the same day. While on a cold, snowy day (August 3), the water of the Indren torrent contained 0·011 gr. (per litre) of sandy detritus, sixty times as much (0·66 gr.) was found on August 10, on an exceedingly warm, sunny day. On a regular summer day, with a mean temperature, the amount of suspended matter in the Indren waters varies from 0·010 gr. in the early morning to 0·09 gr. in the afternoon.

This matter is composed of two kinds of sand: one coarser, which sinks to the bottom in a few hours, and can be severed at once by filtering; and a subtler one, which remains permanently suspended in the waters, passes through the paper, and may only be determined by allowing the water to evaporate and extracting the residue with distilled water to dissolve the soluble salts. The ratio of the two kinds of suspended sand varies with the temperature; the finer one being very scarce, about 14·3 per cent. of the total amount on an average day, rising to 42·0 per cent. when the heat is very great, and when the melting of the ice proceeds with great intensity and speed. This seems to indicate a different origin of the two constituents; the coarse sand being perhaps spread over the surface of the ice fields, and the fine one being enclosed within the glacial masses.

In winter the melting of the glaciers is considerably reduced, and the waters of the Lys, which drain the valley of Gressoney, are nearly clear and transparent.

The amount of dissolved matter—the so-called fixed residue—in the different waters is shown in the following table.

	Milligr. per litre.
Loose, granular ice of the Punta Gnifetti (Signal Kuppe 4561 m.)	16·9
Compact ice of a crevasse at the foot of the Vincent Pyramid (3700 m.)	2·4
Compact ice near the Capanna Gnifetti (ab. 3600 m.)	13·9
,, ,, ,, ,,	8·8
Surface ice of the Garstelet glacier (3300 m.)	1·6
Water of the Salzia lake (2670 m.)	27·2
Water of the Gabiet lake (2339 m.)	25·1
,, ,, ,, ,, ,, ...	23·1
,, ,, Sella spring (about 2250 m.)	30·8
,, ,, Indren torrent (about 2400 m.)	16·1
,, ,, ,, ,, (on a hot day)	21·2

The water obtained from the melting of the ice of the glaciers is the purest of all, in some instances nearly as pure as distilled water. It is very interesting to remark that the amount of dissolved salts in the samples taken in the same glacier, and even in the same spot, is never constant; this shows that the different snow and ice streams which descend from the buttresses of the mountain to form one great ice river, while compressed side by side with the others, still retain their own individuality, and are not confounded together in a uniform mass.

The residues of the waters consisted of sodium and calcium, together with sulphuric and hydrochloric acid; sulphate of lime was prevalent in the lakes and in the Sella spring, the latter showed also the presence of carbonates. Iron (dissolved) was found in traces here and there in the ice-waters. The suspended matter (sand) consisted of silicates with a large amount of iron.

As stated in my letter already referred to, the ice of Monte Rosa contains small quantities of ammonia; the maximum, of 0·3 milligr. per litre, was found in a block of ice at the foot of the great Glacier du Lys, about 2150 m. The waters of streams, lakes, and springs show no ammonia; only during a very hot day the waters of the Indren, which were turbid with an unusual amount of sand, contained a little ammonia, which disappeared in a few hours; the oxygenated compounds of nitrogen (nitrates and nitrites) were absent in every case.

[1] *Giornale della R. Accademia di Medicina di Torino*, anno lviii. fasc. 11, 32 pp.

Muntz and Aubin, as well as Boussingault, came to the same results from the analyses of the meteoric and telluric waters collected above or a little below 3000 metres. The absence of nitric and nitrous compounds in the waters of these heights is perhaps to be explained by the mean elevation of thunderstorms, which generally do not reach the 3000 metres in our zone, and to which the synthesis of those compounds from the elements of the atmosphere is mainly due. But many more accurate meteorological and chemical observations are necessary to confirm this hypothesis on a solid ground.

Among the interesting results of our expedition was the discovery of a substance having all the characters of the cryoconite as described by Nordenskiöld, who first discovered and named it. A fine, black, soot-like, light dust, lying at the bottom of liliputian wells closely spread over the surface of the ice, was collected on the Garstelet glacier, and might perhaps be found on every flat ice-field whose surface is free from the impetuous little rivulets which wash and carry away everything that come in their way.

An immediate analysis of the cryoconite could not be made; I sealed the dust up on the spot in little glass bottles, which were opened later in my laboratory in Turin, when I found that putrefactive processes had taken place; gases, traces of skatol (or indol) together with a fatty (butyric ?) acid had been formed, and the iron—which might have been originally in a metallic condition—was dissolved as ferrous salt, showing the want of oxygen in the air of the bottle.

The presence of organic living matter in the cryoconite is confirmed by the results of an examination of the cryoconite made by Dr. Belli, of the Botanic Institute: he found in the cryoconite:—

Algæ: (Diatomaceæ) *Pinnularia* sp., *Navicula* sp., *Frustulia* sp. (?)
(Cyanophyceæ) *Oscillaria*, sp.
(Chlorophyceæ) *Pleurococcus* sp., *Chroococcus* sp., *Hematococcus pluvialis*, Kh.
Fungi (Bacteriaceæ) *Bacillus* sp., *Bacterium* sp.
,, (Ascomycetes) spores with echinated episporium, difficult to be determined.
Gymnospermæ—Pollen of Coniferæ (Abietineæ ?)

Besides pappi of Compositæ (?) or of Graminaceæ or Cyperaceæ, threads or trychoms belonging to feathery seeds (*Salix*, *Epilobium*, *Clematis* (?).

Of the cryoconite 16 per cent. is organic matter, 3·5 per cent. iron, and the remnant detritus of different minerals.

A study of the distribution of micro-organisms in the ice and waters of Monte Rosa has also been made, and will be shortly published.

PIERO GIACOSA.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. F. W. BURSTALL, Demonstrator of Mechanical Engineering at King's College, London, has been appointed Professor of Civil and Mechanical Engineering at Mason College, Birmingham.

THE London University Commission Bill, which would have passed through the House of Commons this session if all parties had been willing to permit it, has been withdrawn, the Church party having claimed the insertion of a clause embodying a fragment of the Tests Act.

THE action of the North Riding of Yorkshire in adding millinery to the list of technical subjects aided by the funds at their disposal, can hardly be commended. It was not for the purpose of teaching such empirical arts as this, that the Technical Instruction Acts were passed.

THERE does not seem to be a great demand for instruction in technical subjects in Cambridgeshire. At the recent meeting of the County Council a comparative failure of the lectures in agriculture had to be reported, and, following this, one member of the Technical Instruction Committee was understood to say that he supposed the money must be got rid of, but that he did not think it would do sixpennyworth of good! There yet remains much for the advocates of the teaching of natural science to do.

AMONG recent announcements we notice the following:—Dr. Schleiermacher to be Professor of Electro-technics in the Technical High School at Karlsruhe; Dr. Schuberg to be Extraordinary Professor of Zoology in Heidelberg University; Dr.

A. C. Abbott to succeed Dr. Billings in the chair of Hygiene in the University of Pennsylvania; Dr. Franz Hofmeister to succeed the late Prof. Hoppe-Seyler as Professor of Physiological Chemistry in Strassburg University; Prof. P. Jacobsohn to be General Secretary of the German Chemical Society; Drs. Josse and Kämmerer to be Professors of Engineering in the Technical High School of Berlin; Prof. Schmidt, of Stuttgart, to be Director of the Weather Bureau at Würtemburg.

THE Technical Education Committee, in their report to the recent meeting of the Nottinghamshire County Council, called attention to rather an unlooked-for difficulty which had presented itself in connection with their Dairy Institute. It appears that the butter made there is in such request that they had a demand for 1000 lbs. per week, and were actually producing as much as 500 lbs. in this period. The temptation is to convert the institute into a butter-factory, and so into a money-making concern; but the Council supported the Committee in their recommendation that it would be altogether inadvisable to sacrifice the educational interests of the institution to such pecuniary considerations, and that, as in the past, the first aim of the staff must be the instruction of the students.

IT may be thought that the experimental stage in the administration of the Customs and Excise grants to education has been passed, but recent reports seem to negative this idea. The Lancashire committee report that they have been able to allot only eight out of ten science scholarships, the candidates showing a greater preference for the study of art. The Organising Secretary for the Lindsey division of Lincolnshire tells of 868 candidates for technical examinations this year as compared with 1012 last year. We hope that this does not mean that the novelty is wearing off, and that the serious demand for instruction of this kind is really less than had been anticipated. However this may be, there can be no doubt of the wisdom of the grant of £150 by this Council to the Nottingham University College for the year 1896-7.

AT the recent general meeting of the Association of Directors and Organising Secretaries for Technical and Secondary Education the following resolutions were adopted: (1) "That, in the opinion of this Association, it is desirable to ask the Government to receive a deputation to urge upon them the importance of bringing in a Bill early next session dealing with the subject of Secondary Education." (2) "That it is inexpedient to give grants to any non-county borough for building or equipment except upon the terms that such grants shall be returned in the event of such borough becoming a separate educational authority." (3) "That this Association protests against the action of the Science and Art Department in making changes in its grants and regulations for the conduct of its classes without giving due notice to or consulting the local authorities who are so vitally interested in the efficiency of these classes, and particularly urges that the regulations contained in Form 306 be postponed until the issue of the Directory for 1897-98."

THE Organising Secretary for Technical Instruction in the county of Shropshire, in reporting a diminution in the amount of work done in different parts of the county during the past session, observed that it "is ascribable to the vote of the Council in May 1894, by which the fund for technical instruction was reduced to the extent of £3000." This lessening of the grant has been more particularly felt in the towns where the best work was being done by science and art committees. The interruption of a systematic course of training is not, he finds, so serious in rural districts. The diminution complained of is the more to be deplored since already it has been found that the work of the Committee has been productive of practical results, particularly in the ornamental iron and tile manufactories and in the china works of the county. We notice that this Council has provided for the training at suitable institutions of six women as certificated midwives, and that the women have been selected with the view to their being able to follow the calling in parts of the county where there is most need for the services of such skilled nurses.

THE County Committees in charge of technical instruction will do well to take notice of the letter received from the Science and Art Department by the Clerk of the Cornwall County Council, which decides a point of some interest. The letter, which is in reply to a query from the Clerk, runs as follows:—"I am directed to acquaint you that the Department, having already consulted the Local Government Board on the question of the provision of prizes by local authorities, is of opinion that the Cornwall County Council cannot properly apply funds placed at their disposal for the purposes of technical education to awarding prizes (through the medium of local committees) at competitions in agricultural processes to persons other than those who have been taught in classes under the control of, or aided by, the County Council." This decision will prove very salutary, we should think, in view of some of the claims which have been made; for instance, from some districts payments for luncheons, refreshments, ale, spirits, &c., have been demanded—things we should have thought nobody would have supposed connected with technical education.

SCIENTIFIC SERIAL.

Ciel et Terre of July 16 contains an article by M. A. Lancaster, of the Royal Observatory of Brussels, on the intensity of tropical rainfall. There are many points in that zone where the yearly rainfall exceeds 120 inches; such amounts clearly indicate more or less continuous falls of great intensity. The author quotes various excessive amounts observed in periods of twenty-four hours and less, but we extract only a few of the principal falls, reduced to a period of one minute and expressed in inches:—Hong Kong, ·047; Buitenzorg, ·049; Newcastle (New South Wales), ·071; Lahore, ·095; Brussels, ·114; London (Camden Square), ·167. These figures show that the falls of rain in the tropics are not more intense than the extraordinary falls in our own parts, but the former generally exceed the latter in duration; hence the much greater absolute quantity recorded in equatorial regions.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 3.—M. A. Chatin in the chair.—Study of the diamond-bearing sands of Brazil, by M. H. Moissan. From 4·5 kilos. of sand, only 2 gr. of material free from silica was obtained, and this was found to contain a small quantity of gold, platinum and graphite, together with a minute amount of diamond, partly black and partly transparent.—On the oxidation of the organic material of the soil, by MM. P. P. Dehérain and E. Demoussy. At temperatures slightly above 100° the organic material of soil is rapidly burnt by the oxygen of the air. This oxidation still goes on, without any organisms being present, at 40° to 60° C., and hence in hot climates the soil would become sterile from this cause.—On a hybrid from *Ovis tragelaphus*, by M. A. Milne-Edwards.—An extension of the application of the law of equivalence of energy in biology, by M. A. Chauveau.—Remarks on a note of M. A. Lœwy on definite quadratic forms, by M. L. Fuchs. The theorem in question is a special case of a theorem given in a memoir published in the *Sitzungsberichte* of the Berlin Academy.—The conditions under which the deposits of phosphate of lime have taken place in Picardy, by M. Gosselet. It is regarded as established that these phosphatic deposits were formed at very slight depths.—On the integration of simultaneous partial differential equations, by M. E. von Weber.—On a class of isothermal surfaces depending on two arbitrary functions, by M. A. Thybaut.—On the error of refraction in geometric levelling, by M. Ch. Lallemand. The formulæ given in a preceding paper are for practical purposes given in a graphical form.—On the non-refractibility of the X-rays by potassium, by M. F. Beaulard. A prism of potassium gave no appreciable deviation of Röntgen rays, the index of refraction differing from unity by a quantity less than 1/10,000.—Nitrogen and argon in fire-damp and in gas from Rochebelle, by M. Th. Schlœsing, jun. The gas left after removal of methane and carbon dioxide, consisting of argon and nitrogen, on absorbing the latter gave amounts of argon varying from 1·09 per cent. to 3·27 per cent. of the mixture. These figures show that this argon does not come directly from the air, but it is still possible that it may have come indirectly by solution in water, in which argon is the more soluble.—On the specific heat of sulphur in the viscous state, by M. J. Dussy. The specific heat of viscous sulphur is distinctly higher in the viscous than in the liquid state. If the total quantity of heat lost by 1 gr. of sulphur in passing from a temperature T to 0° C. is plotted against the temperature, there is a distinct change of curvature at about 230° C.—Contributions

to the analytical characters of the compounds of tungsten, by M. E. Defacoz. The tungsten compound is converted into a tungstate, heated with some $KHSO_4$ and a little sulphuric acid, and a drop of this, added to such reagents as phenol, naphthol, morphine, &c., when characteristic colour reactions occur. Of these the red coloration with phenol, and the violet with hydroquinol, are the most sensitive and distinctive.—On the action of aluminium chloride upon benzene containing thiophene, by M. Eyvind Boedtker. Hydrogen sulphide is evolved, and the bulk of the thiophene is destroyed.—On some new mixed trimethylene compounds, by M. L. Henry. The new substances described are α-iodo-ω-chloro-propane, $CH_2Cl.CH_2.CH_2I$; and the corresponding nitro-derivative, $CH_2Cl—CH_2.CH_2.(NO_2)$.—The rapid estimation of the constituents of a mixture of primary, secondary, and tertiary amines, having the same fatty alkyl group, by M. Ch. Gassmann. The mixture is titrated with hydrochloric acid, and then with sodium nitrite in acid solution; the solution of the resulting simultaneous equations gives results of sufficient accuracy for industrial purposes.—On the compounds oxidisable under the influence of the oxidising ferment of mushrooms, by M. Em. Bourquelot.—On the hybernation of the *Clavelina lepadiformis* (Müller), by MM. A. Giard and M. Caullery.—Treatment of experimental infections by intravenous injection of a solution of common salt (0·7 per cent.), and their mode of action, by MM. F. J. Bosc and V. Vedel.—On the nature of the "Chabins," by M. Ch. Cornevin. The Chabin (so-called by Gay) of Chili is not a hybrid, but a species of sheep.—Chemical study of low-class flour used in baking, by M. Balland.—On the proximate composition of the gluten of cereals, by M. E. Fleurent.

AMSTERDAM.

Royal Academy of Sciences, June 27.—Prof. van de Sande Bakhuyzen in the chair.—Mr. C. Eykman presented for publication in the Academy's *Transactions* a paper on the respiratory gas interchange of the inhabitants of the tropics. The principal result of the experiments made at Batavia with Geppert and Zuntz's apparatus, on persons in a state of rest was, that both the European and the Malayan inhabitant of the tropics, the weight of their bodies being reduced to the same standard, use the same quantity of oxygen, and consequently produce the same amount of heat, as the inhabitant of the temperate zones, to whom the same test has been applied. Moreover, the ratio of the quantity of carbonic acid exhaled to that of oxygen inhaled by Europeans, is pretty much the same in India as in Europe; with Malayans the amount of carbonic acid exhaled is comparatively a little greater, which is accounted for by the food of the latter being richer in carbohydrates.—Prof. van Bemmelen communicated the result of an investigation into the proportion of fluorine in the fossil bones from the Pliocene formation in Middle-Java (Dubois' collection), which proportion was determined by the author in co-operation with Mr. Klobbie. He also treated of the coefficient of distribution in the absorption of dissolved substances by colloids.—Prof. van de Sande Bakhuyzen dealt with the determination of the error of projection in the case of Repsold's instrument for measuring photographs of stars.—Prof. Kamerlingh Onnes presented a continuation of his observations on the measurement of low temperatures.—Mr. Verschaffelt described measurements of capillary ascents of liquid carbon near the critical temperature. In his thermodynamic theory of capillarity, Prof. van der Waals has calculated, on theoretical grounds, the surface energy of a liquid near the critical temperature. He arrives at the conclusion that, at least if the temperature is very nearly critical, it must be possible to represent the surface energy by the formula, $\sigma = A (1 - m) 3/2$, in which A is a constant, and m the reduced temperature. The values of σ, deduced from experiments made by de Vries, and by Ramsay and Shields, may now be represented by a formula $\sigma = A (1 - m)B$, in which B is generally constant and smaller than 3/2, though in a few cases it gradually increases, in proportion as the critical point is approached. It was, therefore, desirable to measure some ascents, when the temperature was still nearer the critical point; and liquid carbonic acid was selected for this investigation. Up to 30° the change of the height of ascent is pretty nearly linear; for a capillary of a radius $r = 0{\cdot}0441$ mM, it was found that

$$\mathrm{H}m\mathrm{M} = 26{\cdot}04 - 0{\cdot}825\, t.$$

As this line cuts the temperature axis at 31°·6, and as the critical point, where H must be = 0, was found to be 31°·0, the "height-of-ascent" curve must incline a little towards the temperature axis between 30° and 31°, which was actually observed. For the calculation of the surface energy the liquid and gas densities determined by Amagat were used. Cailletet and Mathias have constructed parabolic formulæ for those densities, from which follows, it would seem, $\int v - \int d = k \sqrt{1 - m}$. According to van der Waals this relation must be theoretically satisfied, at least near the critical temperature. When the quotient

$$\Delta \log \left(\int v - \int d\right) / \Delta \log (1 - m)$$

is now deduced from the densities, given by Amagat, then it appears that up to about 30° it remains pretty nearly constant, the mean being 0·367, consequently smaller than the value derived from Cailletet's and Mathias's formulæ; above 30° it rises and reaches the value 0·521, in accordance with the theory. As regards $\Delta \log \sigma / \Delta \log (1 - m)$, which, according to van der Waals, must become equal to 1·5 in the immediate proximity of the critical temperature, the calculation shows that this quotient becomes smaller up to 29°, but then it increases again, the maximum found being 1·512.—Prof. Engelmann communicated the result of investigations into the origin of the normal movement of the heart, from which it appears that very probably it is not of a neurogenic, but of a purely myogenic nature.—Prof. Franchimont presented, on behalf of Dr. P. van Romburgh, of Buitenzorg, a paper on the action of iodine upon potassium cyanide, and of iodine cyanide upon caustic potash, in which it is proved that the opinion that iodine cyanide behaves differently from potassium, from bromine- and chlorine-cyanide, is founded on an error, which has probably originated in not awaiting the end of the reaction, on making the experiments. After twenty-five minutes the final products are: at 25°, potassium isocyanate and potassium iodide; they are also obtained by adding iodine to an alkaline potassium cyanide solution, when for a moment the smell of iodine cyanide is observed. The concentration seems not to have any influence upon the result, but it has upon the rapidity of the reaction.

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